

User Manual

使用手册

Altus Digital Recorder

Altus 数字记录器

文件 302200 Document 302200

版本 I

Revision I

2002 年 4 月

April 2002

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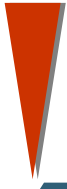
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KINEMETRIX INC.

Warranty

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We warrant each new product manufactured by Kinemetrix for a period of one year from date of shipment. Defects in material or workmanship found within that period will be replaced or repaired (at our option) without charge for materials or labor. If Kinemetrix authorizes the return of a product, we will pay the round trip freight charges to the factory for repair under warranty. If subsequent evaluation at Kinemetrix establishes that necessary repairs are due to misuse, then the customer must assume all charges.

Insurance for all shipments, either first sale or repair, are the responsibility of the customer. Kinemetrix can arrange to have a policy purchased on behalf of the customer for the first sale; however, it is the responsibility of the customer to notify the carrier immediately of any freight or handling damage. Kinemetrix will make every effort to assist the customer in filing a claim with the carrier or insurance company.

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本手册中文翻译内容仅供阅读英文原文时参考

Complete and
return this
card
完成及返回此卡



Service Card

Model: _____

S/N _____

Date: _____

Please add me to your Service Bulletin mail list.....☐

I would like to receive more information on your service for:

Installation	<input type="checkbox"/>	Repair	<input type="checkbox"/>
Maintenance.....	<input type="checkbox"/>	Data Reduction	<input type="checkbox"/>
Calibration	<input type="checkbox"/>	Training	<input type="checkbox"/>
..... <input type="checkbox"/>			

My responsibilities can be described as:

Lab Manager	<input type="checkbox"/>
Instrumentation technician	<input type="checkbox"/>
Field Engineer	<input type="checkbox"/>

I would like to purchase a Service Manual for my instrument if it is available

.....☐

.....☐

My name is _____

Title _____

Company _____

Address _____

City _____

State _____ Zip _____

Tel () _____

Services available from Kinometrics

可由 Kinometrics 公司提供的服务

Installation 安装

Field support for on-site installation, supervision and check-out of Kinometrics products is available from Kinometrics. Training for the customer's staff is also available, either at Kinometrics' facilities in Pasadena, or at the customer's site. We recommend contracting for installation services along with instrument procurement. Kinometrics 公司可提供对于 Kinometrics 产品的现场安装、督察和检查等现场支持。并可为客户的工作人员提供技术培训，培训地点在帕萨迪纳市 Kinometrics 公司本部或客户指定的场地均可。我们建议将仪器交接与现场服务集中进行。

Maintenance 维护

Periodic field maintenance programs are offered for our products. Current programs include annual contracts to service accelerographs in high-rise buildings, free-field accelerographs, offshore platform monitoring systems, maintenance at nuclear power plants and seismic network maintenance. 对于我们的产品可以提供定期现场维护服务计划。通常的计划包括高丛建筑的加速度仪、自由场地加速度仪、；离岸浅海平台监测系统、核发电厂地震监测系统及地震台网等的年度维护服务合同。

Recalibration and Repair 重校准和返修

Kinometrics will repair and/or modify many types of electromechanical instruments and systems. All repair and calibrations are warranted for a period of 90 days for workmanship. European customers may contact Kinometrics SA for assistance at Le Trési 3, 1028 Préverenges, Switzerland; E-mail: kmi_sa@bluewin.ch; telephone 021-803 28 29; fax 021-803 28 95. Kinometrics 公司将可以修理和/或更改多种类型的电子机械仪器和系统。所有修理和校准担保为期 90 个工作日。欧洲客户请接触 Kinometrics 公司驻瑞士办事处户的帮助。

Data Reduction 数据整理

Kinometrics offers digitization of records, conversion of data to engineering units, amplitude compensation, decimation, baseline correction, integration and differentiation, digital filtering, Fourier spectrum and response spectrum computation, plotting, and output of tapes for the customer's use. Kinometrics 公司可依客户使用需要提供记录数字化、数据工程单位转换、振幅校准、筛选、基线校正、积分、微分、数字滤波、富利叶谱和反应谱计算、绘图和磁带输出等服务。

For Faster Service 为了更快地获得服务

When returning any product to Kinometrics, please request an RMA number and make reference to this number in any following correspondence. 当需要返回任何产品到 Kinometrics 公司时，请要求一个 RMA（返修管理办公室）的号码，并在随后的信件联系中提及这个 RMA 号码。



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NO POSTAGE
NECESSARY
IF MAILED
IN THE
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222 VISTA AVE
PASADENA CA 91107-9880



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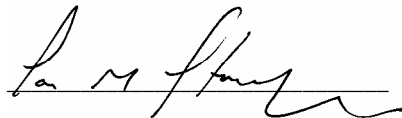
222 VISTA AVENUE
PASADENA, CA 91107
USA

*hereby declare that the equipment specified conforms to the following
Directives and Standards:*

Product Name:	Kinematics Altus K2 Systems
Product Description:	Strong Motion Recording Systems
Model Number(s):	K2 12-channel, K2 6-channel, K2 4-channel, GPS Option, Modem Option, External Sensors Option, FBA- 23, FBA-23DH
Directives:	89/336/EEC, 73/23/EEC (93/68/EEC)
Standards:	Safety: EN 61010-1 EMC: EN 55022, Class A EN 50082-2

Supplementary Information:

Pasadena, CA USA
14 August 1997



IAN M. STANDLEY
VICE PRESIDENT, ENGINEERING

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安全 Safety

Symbols & Terms 符号和术语

These symbols may appear on Kinometrics equipment or in this manual:

下述符号可能出现在 Kinometrics 的设备上或本使用手册中：



When you see this symbol, *pay careful attention*. Refer to the similarly marked, relevant part of this manual before servicing the instrument.

当你看见这个符号时需加倍小心。在保养仪器前，请参考本手册类此标记的相关部分。



This symbol means a *low-noise earth ground*. The noted item should be grounded to ensure low-noise operation, and to serve as a ground return for EMI/RFI and transients. Such a ground *does not work as a safety ground* for protection against electrical shock!

这个符号表示低噪声接地。应特别注意它应是保证低噪声运行和提供作为 EMI/RFI 及瞬变接地回路的接地线。如此接地不是作为防护电冲击的安全接地用的！



This symbol means an alternating current (AC) power line.

这个符号表示交流(AC)电源线。



This symbol means a direct current (DC) power line derived from an AC power line.

这个符号表示源自交流(AC)电源的直流(DC)电源线。



This symbol indicates an electrostatic sensitive device (ESD), meaning that when handling the marked equipment you should observe all standard precautions for handling such devices.

这个符号指示出了一个静电敏感设备器件装置(ESD)，当触摸有此标记的装置时你必须遵守所有为触摸此类装置所需的常规预防措施。



This symbol indicates that a particular step/process or procedure is required to ensure the installation maintains conformity to European requirements.

这个符号指示出了为保证安装维持对欧洲共同市场规定的遵从所需要的独特的步骤/过程或程序。

These safety-related terms appear in this manual:

下列呈现在本文里的与安全相关的术语：

Note: Statements identify information that you should consider before moving to the next instruction or choice.

注释：陈述指明你在做下一步指示或选择行动之前所应予考虑的信息。

Caution statements identify conditions or practices that could result in damage to the equipment, the software, or other property.

告诫：陈述指明能够对设备、软件或其他物件产生危险的情况和实践。

WARNING! statements identify conditions or practices that could result in personal injury or loss of life.

警告！陈述指明能够产生人身伤害或生命损失的情况和实践。

Specific Precautions 特定预防措施

Follow the precautions below to ensure your personal safety and prevent damage to your Altus digital recorder.

遵从下面的预防措施可保障你的人身安全和防止你的 Altus 数字记录器的损害。

The recorder is powered by an 18-24 VDC or 12 VDC supplied by the power supply assembly, from external batteries or from the solar charging system. The recorder can also contain an internal battery that can power the unit when external power sources fail.

记录器由一个 18-24VDC 或 12VDC 电源装置供电，该装置可由外接电池或太阳能充电系统提供。记录器也可装置内电池，一旦外电源失效它就提供记录器用电。

OPTIONAL POWER SUPPLY ASSEMBLY 可选的供电装置

If you plan to power the recorder from the mains supply, we recommend Kinometrics' Power Supply Assembly (PSA). Plug the PSA's power cord into AC outlets that *will not apply* more than 260 Vrms between the supply

conductors or between either supply conductor and ground. A protective ground connection (provided through the grounding conductor in the PSA and its power cord) is essential for safe operation. The PSA is designed for indoor use only; it must not be subject to immersion in water, high humidity, or temperatures above 70°C.

若你计划从主电源给记录器供电，我们建议用 Kinometrics 供电装置 (PSA)。供电装置(PSA)以市电交流输入，其两极间或极地间电压不得大于 260Vrms。保护接地连接(通过在 PSA 及其电源线里的接地导线提供的)对安全运行是必需的。供电装置(PSA)仅供室内使用，不能让它浸水，处于高的湿度或大于 70 ° C 的温度中。

USER-SUPPLIED BATTERIES OR CHARGING SYSTEM 用户自己提供电池或充电器

If you supply your own charging system, make sure the system provides the correct voltage and current required by the recorder. If you derive power from the mains supply, make sure there is adequate grounding for all the equipment. If you supply your own batteries, follow the warnings below.

若你提供你自己的充电系统，务须使该系统提供符合记录器需要的电压和电流。若你由主电源供电，务须对所有设备都做好适当的接地。若你提供你自己的电池，请遵从下面的警告。

INTERNAL BATTERY 内置电池

Follow the precautions in this manual when handling and replacing the internal battery. Metallic instruments of any kind could short the battery terminals, resulting in fire or explosion. Do not drop the battery or attempt to disassemble it. When charging the battery, use a properly rated charger and do not overcharge the battery. The only correct replacement battery is a sealed lead-acid battery with relief vents and ratings comparable to the original battery. Never use a non-rechargeable battery in the recorder.

当触碰和置换内置电池时，请遵从本手册中的预防措施。任何一种金属工具都可能造成电池两极短路，产生失火或爆炸。不可摔打电池或试图拆卸它。当给电池充电时，需用适当量值的充电器，并且不能对电池过充电。唯一恰当的可置换电池是具有等同于原来的电池的排卸压气孔和额定值的密封铅酸电池。切切不可用非可充电电池装进记录器里。

GROUNDING THE RECORDER & SYSTEM 记录器和系统的接地

When using the PSA to power the recorder from the AC mains supply, remember that the recorder is grounded through the PSA power cord. To avoid electric shock, plug the PSA cord into a properly wired receptacle where the protective earth ground has been verified. Do this verification *before* making any power connections to the recorder.

当用 PSA 供电装置作为从 AC 主电源向记录器供电，请记住记录器是通过 PSD 电源线接地的。为避免电冲击，PSA 电源线应插入已被证实是具有接地保护的适合的插座内。在将任何电源连接到记录器之前务请核实这点。

USE THE PROPER POWER CORD 使用正规的电源线

Use the power cord and connector supplied with PSA, or an equivalent IEC-standard power cord. Be sure that it is in good condition.

请使用 PSA 提供的电源线和连接器，或等同的 IEC-标准电源线。确认它处于最好的状态。

USE THE PROPER FUSES 使用正规的熔断丝

To avoid fire hazard, use only the fuses specified in Chapter 4, *Maintenance and Service*. Match them by type, voltage rating and current rating. Fuses should only be replaced by a qualified technician and the instrument must be disconnected from all power sources *before* touching the fuses.

为了避免火灾，仅可使用在第四章维护和服务中指明的熔断丝。使它们与规定的型号、电压额定值及电流额定值相符。熔断丝只能由高素质的技术人员去更换，并且在触碰熔断丝之前必须切断仪器的所有电源。

SENSOR CABLING & GROUNDING 传感器电缆架设和接地

In installations where sensors are mounted some distance from the recorder, and where both sensors and the recorder are grounded locally, it is very important to make sure that all connected units are grounded at the same voltage. Otherwise, potentially lethal voltages could result on the connecting cables.

当传感器被安装在与记录器有一定距离的场合，和当传感器与记录器都在本地接地的场合，必定要使所有相连的单元接地电压相同，这一点十分重要。否则，在连接电缆上可能产生潜在的致命电压。

DO NOT OPERATE IN EXPLOSIVE ATMOSPHERES 不要在易爆大气环境中运行

The recorder and the PSA provide *no explosive protection* from static discharges or arcing components. *Do not* operate the equipment in an atmosphere of explosive gases.

记录器和 PSA 都没有提供由于静电释放或电弧成分引致爆破的保护。不能在易爆气体大气环境中操作这类设备。

Sicherheit

Symbole & Begriffe

Diese *Symbole* können auf Kinematics Geräte oder in diesen Manuel erscheinen:



Bedeutet *Achtung!* Wenn sie dieses Symbol auf ein Gerät sehen, muss den gleich markierten Teil dieses Manuels beachtet werden. *Bevor* irgend eine Unterhaltsarbeit angefangen wird, *muss* dieser Teil des Manuels gelesen werden. Wenn Sie dieses Symbol sehen, bitte besondere Achtung geben.



Bedeutet Erdung. Das erwante Teil sollte geerdet werden, um eine "low noise" operation zu versichern, und dann auch als Erdung für EMI/ FRI und Transienten und solch eine Erdung wird *nicht als Sicherheit gegen* elektrischen Schock dienen!



Bedeutet *Wechselstromzufuhr* (AC) mit Elektroschock Gefahr.



Bedeutet Gleichstromzufuhr von AC Versorgung herkommend.



Bedeutet *Elektrostatisch Sensibeles Element (ESD)* für dessen Handhabung alle vorbeugende Vorsichtsmassnahmen genommen werden müssen.



Dies Symbol zeigt an, daß ein spezieller Vorgang oder Prozedur nötig ist um sicher zu stellen, daß die Installation Europäischen Anforderungen genügt.

Folgende *Darstellungen* werden in diesen Manuel erscheinen:

Note: Darstellung welche Informationen Sie erhalten, die besonders beachtet werden müssen, bevor sie zum nächsten Schritt gehen.

<p>Caution: Darstellung bei dem die Missachtung in der Regel Gefahr für Defekte und Störungen im Gerät, Programm oder Zubehör besteht.</p>

WARNING! Darstellung bei dem die Missachtung in der Regel Verletzungen – oder Lebensgefahr besteht.

Spezielle vorbeugende Massnahmen

Alle vorbeugende Massnahmen müssen beachtet werden für Ihre persönliche Sicherheit, und um Schäden im K2 oder Makalu Digitales Aufzeichnungsgeraet und System zu vermeiden.

STROMVERSORGUNG

Die Stromversorgung des digitales Aufzeichnungsgeraet braucht 18-24 VDC (sehr wahrscheinlich vom optionellen Netz-Stromversorgungs/ Ladegerät), oder 12VDC von Ihren eigenen externen Batterien oder Solar-Ladesystem. Die Aufzeichnungsgeraet kann auch seine eigenen Batterie enthalten, welche dafür entwickelt ist, um das System mit Strom zu versorgen, wenn die externe Stromversorgung entfällt. Unbeachtet welche Stromversorgung gebraucht wird, müssen alle vorbeugende Massnahmen eingehalten werden.

OPTIONELLES STROMVERSORGUNGS/LADEGERÄT

Falls geplant wird, die Aufzeichnungsgeraet mit dem Netz zu speisen, empfehlen wir das Kinometrics Stromversorgungs/Ladegerät (Power Supply Assembly, PSA). Sie müssen dabei nur den PSA-Netzstecker einstecken (100-260VAC stufenlos). Die Erdung (mit der Erdungsleiter im Netzkabel) ist nötig für gefahrlose Arbeit vom digitales Aufzeichnungsgeraet. Das PSA ist nur für Innengebrauch, es darf nicht Wasser, hoher Luftfeuchtigkeit oder Temperaturen über 70°C ausgesetzt werden.

BATTERIEN ODER LADESYSTEM DURCH BENUTZER GELIEFERT

Falls sie ihr eigenes Ladesystem gebrauchen, müssen sie sicherstellen, dass es die durch das System benötigte Spannung und Strom liefert. Sie sind allein verantwortlich für die Sicherheit ihres Ladesystems. Wenn sie das System mit dem Netz speisen, müssen Sie sicherstellen, dass eine korrekte Erdung für das ganze System vorhanden ist. Falls sie ihre eigene Batterien benutzen, müssen sie die unterstehenden Warnungen beachten.

INTERNE BATTERIEN

Sie müssen die internen Batterien von Aufzeichnungsgeraet in voller Uebereinstimmung mit den vorbeugenden Massnahmen, die diesen Manuel beschrieben sind, handhaben und auswechseln. Sie müssen **EXTREM VORSICHTIG** sein, um sicherzustellen, dass zwischen die Kontakte der Batterie kein Kurzschluss entsteht. Es besteht *Feuer-und Explosionsgefahr!* In keinem Fall sollten die Batterien geworfen oder auseinander genommen werden. Wenn Sie die Batterien aus dem Aufzeichnungsgeraet entnehmen, um zu laden, dann müssen Sie ein entsprechendes Ladegerät gebrauchen, und sicherstellen, dass die Batterien nicht überladen werden.

ERDUNG DES DIGITALES AUFZEICHNUNGSGERAET UND SYSTEM

Wenn Sie das Stromversorgungs/Ladegerät gebrauchen, um die Aufzeichnungsgeraet vom Netz zu speisen, dann erden sie die Aufzeichnungsgeraet durch das Netzkabel mit der Erdung der Steckdose. Um ein Elektroschock zu vermeiden, müssen sie sicherstellen, dass die Erdung der Steckdose getestet ist. Tuen Sie dieses bitte ehe Sie das Aufzeichnungsgeraet digitales Aufzeichnungsgeraet am Netz anschliessen.

GEBRAUCH VOM EIGENEN NETZKABEL

Falls Sie das Stromversorgungs/Ladegerät gebrauchen, stellen Sie sicher, dass nur das mitgelieferte Netzkabel (oder ein equivalentes IEC-standard Netzkabel) gebraucht wird. Benutzen Sie nur ein Kabel in gutem Zustand.

GEBRAUCH VON EIGENE SICHERUNGEN

Um Feuer zu vermeiden, gebrauchen Sie nur Sicherungen die im Kapitel 4 in diesem Manuel beschrieben sind. Stellen sie sicher, das Spannung *und* Strom übereinstimmen. Sicherungen sollten nur durch einen qualifizierten Techniker ausgewechselt werden. Sie müssen sicherstellen, dass das Gerät nicht mehr an eine Stromversorgung angeschlossen ist, bevor eine Sicherung ausgewechselt wird.

VERKABLUNG UND ERDUNG VOM SENSOR

In Installationen, wo FBA Sensoren vom Aufzeichnungsgeraet entfernt montiert sind und wo beide Sensoren und die Aufzeichnungsgeraet lokal geerdet sind, ist es sehr wichtig, dass sichergestellt wird, dass alle angeschlossenen Einheiten am gleichen Spannungspotential geerdet werden. Es könnten anderenfalls gefährliche Spannungspotentiale im Kabel entstehen.

NICHT IN EXPLOSIONSGEFÄHRDETE UMGEBUNG GEBRAUCHEN

Der Aufzeichnungsgeraet und das Stromversorgungs/Ladegerät haben KEINE EXPLOSIONS-SCHUTZ von statische Entladungen oder funkgefährdete Bauteile. Gebrauchen sie die Geräte NICHT in Umgebungen mit explosiven Gasen.

Seguridad

Símbolos & Términos

Estos *símbolos* podrían aparecer en los equipos Kinometrics o en este manual:



Significa *poner atención!* Cuando Usted vea este símbolo en el instrumento, referirse a las partes de este manual marcadas similarmente. *Antes* de intentar cualquier servicio en este instrumento, Usted *tiene que* leer las partes relevantes de este manual. Si Usted ve este símbolo, ponga atención cuidadosamente.



Significa un *polo a tierra de bajo ruido*. El ítem referido debe estar polarizado a tierra para asegurar la operación a bajo ruido y además sirve como un retorno a tierra para el EMI/RFI y transitorios. Tal polo a tierra no trabaja como un polo a tierra de seguridad para protección contra choques eléctricos!



Significa una *línea de energía de Corriente Alterna (AC)*.



Significa una línea de energía de Corriente Directa derivada de una línea de energía AC.



Significa una *Unidad Sensitiva a Electrostática (Electrostatic Sensitive Device ESD)*, indicando que usted debe tener cuidado y observar todas las precauciones para el manejo de tales unidades.



Significa que un paso de progresión un proceso o un procedimiento determinado está requerido para asegurar la instalación mantiene conformidad a los requisitos europeos.

Estos *términos* aparecerán en este manual:

Note: sentencias identificando información que Usted debe considerar cuidadosamente antes de dirigirse a la siguiente instrucción u opción.

Caution: sentencias identificando condiciones o practicas que podrían resultar en daño del equipo, el software u otra propiedad.

WARNING! sentencias identificando condiciones o practicas que podrían resultar en una lesión personal o la perdida de la vida.

Precauciones Específicas

Observe todas estas precauciones para garantizar su seguridad personal, y prevenir el daño a cualquiera de los equipos en su Registrador y Sistema.

FUENTE DE PODER

Para energizar el Registrador, usted necesita proveer 18-24 VDC (probablemente derivado de la fuente principal de poder, opcional, Fuente de Poder/Cargador (descrito más adelante) o 12 VDC suministrado desde su propias baterías externas o sistema de carga solar. El Registrador además puede contener su propia batería (descrito en detalle más adelante), el cual está diseñado para energizar la unidad cuando las fuentes externas fallan. Independiente de la fuente de poder que Usted use, usted tiene que ejercitar todas las precauciones de seguridad necesarias.

FUENTE DE PODER/CARGADOR OPCIONAL

Si Usted planea energizar el Registrador desde el suministro principal, nosotros recomendamos la Fuente de Poder/Cargador (Power Supply Assembly o PSA) de Kinometrics. Usted solo debe conectar el cable de energía del PSA al toma corriente AC que no aplique más de 260 Vrms entre los conductores del suministro o entre el conductor del suministro y el polo a tierra. Una conexión con protección a tierra (provista a través del conductor de tierra en la Fuente de Poder/Cargador y su Cable de Energía) es esencial para una operación segura del registrador. El PSA está diseñado para uso en interiores únicamente; no tiene que ser sujeto a inmersión en agua, alta humedad o temperaturas sobre 70°C.

SISTEMA DE CARGA O BATERÍA PROVISTO POR EL USUARIO

Si Usted provee su propio sistema de carga, Usted tiene que estar seguro que el sistema proporciona el voltaje correcto y la corriente requerida por el sistema y solamente Usted es responsable por la seguridad de su sistema de carga. Si Usted deriva energía del suministro principal, Usted tiene que asegurarse que ha provisto un polo a tierra adecuado a todo el equipo. Si Usted suministra sus propias baterías, Usted debe seguir las advertencias proporcionadas más adelante.

BATERÍAS INTERNAS

Usted debe manejar y reemplazar las baterías internas del Registrador en completa concordancia con las precauciones en este manual. Usted debe ejercitar **MAS PRECAUCION** para asegurarse que los terminales de las baterías no están en cortocircuito por ningún instrumento metálico de ningún tipo. *Fuego y explosión puede resultar!* Bajo ninguna circunstancia Usted dejará caer las baterías o intentará desensamblarlas. Si Usted toma las baterías fuera del Registrador para cargarlas, Usted tiene que usar un cargador ajustado apropiadamente y tiene que tomar el cuidado de no sobre cargarlas.

POLARIZANDO EL REGISTRADOR DIGITAL Y SISTEMA

Si Usted usa la Fuente de Poder/Cargador para energizar el Registrador desde el suministro principal de AC, entonces Usted esta polarizando el Registrador a través del Cable de Energía corriendo desde el toma corriente AC a la Fuente de Poder/Cargador. Para evitar choques eléctricos, conecte el Cable de la Fuente de Poder/Cargador en un receptáculo apropiadamente alambrado donde el polo a tierra de protección ha sido verificado. Haga esta verificación *antes* de hacer ninguna conexión de energía a el registrador digital.

USE EL CABLE DE ENERGÍA APROPIADOS

Si Usted usa la Fuente de Poder/Cargador, asegúrese que Usted usa solamente el Cable de Energía y conector suministrado con esa Fuente de Poder/Cargador (o un cable de energía estándar IEC equivalente). Use solamente un Cable de Energía que este en buenas condiciones.

USE LOS FUSIBLES APROPIADOS

Para evitar la amenaza de fuego, use solamente los fusibles especificados en la *Maintenance & Service* sección de este manual. Asegúrese de cotejarlos por tipo, tasa de voltaje y tasa de corriente. Los fusibles deben ser únicamente reemplazados por un técnico calificado y Usted debe asegurarse que el instrumento esta desconectado de toda fuente de energía *antes* de tocar los fusibles.

CABLEADO Y POLARIZADO DEL SENSOR

En instalaciones donde los sensores están montados a cierta distancia desde el Registrador, y donde ambos sensores y el Registrador están polarizados a tierra localmente, es muy importante estar seguro que todas las conexiones están polarizadas a tierra al mismo voltaje. De otra manera, potencialmente voltajes letales podrían resultar en los cables de conexión.

NO OPERAR EN ATMÓSFERAS EXPLOSIVAS

El Registrador y la Fuente de Poder/Cargador NO provee PROTECCION EXPLOSIVA para descargas estáticas o componentes que generen arcos eléctricos. NO operar el equipo en una atmósfera de gases explosivos.

Sécurité

Symboles & Terminologie

Les *symboles* suivant peuvent figurer sur les équipements Kinematics ou dans ce manuel:



Signifie *Attention!* Quand vous rencontrez ce symbole sur un instrument, veuillez vous référer à la section de ce manuel signalée par la même marque. *Avant* même d'effectuer la première opération sur l'instrument, vous devez lire la section correspondante de ce manuel. Faites attention si vous voyez cet symbole.



Indique une mise à la terre "faible bruit". Les objets portant cette marque doivent être reliés à la terre afin d'assurer un fonctionnement optimal. Elle est aussi utilisée pour les éléments de protection contre les interférences magnétiques, les perturbations hautes fréquences radio et contre les surtensions. Cette mise à terre *n'est pas une mise à terre de sécurité* pour une protection contre les chocs électriques!



Indique une *alimentation en courant alternatif* (AC).



Indique une Alimentation en courant continu (DC) dérivée d'une alimentation alternative



Indique la présence d'un *composant sensible aux décharges électrostatiques* (ESD), Cela signifie qu'il faut observer toutes les précautions d'usage en manipulant ce composant.



Le symbole indique qu'une procédure est requise pour s'assurer que l'installation est conforme à la réglementation Européenne.

Les *termes* suivant apparaissent dans ce manuel:

Note: Indique la présence d'une information que vous devez particulièrement considérer avant de passer à la prochaine instruction or operation.

Caution: Indique une condition ou opération qui peut entraîner des dommages à votre équipement, au logiciel ou à d'autres propriétés .

WARNING! Indique une condition ou opération qui peut entraîner des blessures corporelles ou la perte de la vie.

Précautions Spécifiques

Observez toutes les précautions suivantes afin d'assurer votre sécurité personnelle et de prévenir des dégâts aux composants de votre Système et Enregistreur Numérique.

ALIMENTATION

Pour alimenter votre Enregistreur Numérique, vous devez fournir 18-24 VDC (probablement dérivé du réseau principal, ou en utilisant l'alimentation/chargeur décrit ci-dessous), ou du 12 VDC fourni par votre propre batterie externe ou système d'alimentation solaire. Le Enregistreur est aussi équipé de sa propre batterie interne (décrit ci-dessous), qui permet d'alimenter le système en cas de perte d'alimentation externe. Vous devez observer toutes les précautions de sécurité pour toutes les différentes possibilités d'alimentation.

OPTION ALIMENTATION/CHARGEUR

Si vous désirez alimenter votre Enregistreur par le réseau, nous recommandons l'utilisation de l'alimentation/chargeur fourni par Kinometrics (PSA). Vous devez connecter le cordon d'alimentation du PSA uniquement dans une prise Alternative ne délivrant pas plus que 260 Vrms entre deux conducteurs ou entre un conducteur et la terre. Une mise à la terre de protection (mise à disposition au travers du conducteur de terre de l'alimentation/chargeur and du cordon d'alimentation) est essentielle for un fonctionnement en toute sécurité de l'enregistreur numérique. Le PSA est prévu pour une utilisation en intérieur uniquement; il ne doit pas être immergé dans de l'eau, dans une haute humidité ambiante ou une température de plus de 70°C.

AUTRES BATTERIES ET CHARGEURS

Au cas où vous utilisez votre propre chargeur, vous devez vous assurer que votre système délivre une tension correcte et le courant requis par le Enregistreur. Dans ce cas, vous être seul responsable pour la sécurité de votre chargeur. Si vous branchez votre système de charge sur le réseau de distribution principal, vous devez vous assurer d'installer les mises à terre adéquates pour tout votre équipement. Si vous utilisez vos propres batteries vous devez vous référer aux avertissements ci-dessous.

BATTERIES INTERNES

Vous devez manipuler et remplacer les batteries internes du Enregistreur en respectant pleinement les précautions incluses dans ce manuel. Vous devez faire **PARTICULIEREMENT ATTENTION** de ne pas court-circuiter les cosses des batteries avec une pièce métallique quelconque. *Cela pourrait provoquer des incendies et explosions!* En aucun cas vous ne devez laisser tomber les batteries

ou essayer de les démonter. Si vous enlevez les batteries du Enregistreur, afin de les recharger, vous devez ajuster le courant de charge correctement et devez prendre soins de ne pas surcharger les batteries.

MISE À TERRE DU SYSTÈME ENREGISTREUR NUMÉRIQUE

Dans le cas où vous utilisez l'alimentation / chargeur pour alimenter le Enregistreur à partir du réseau, alors, la mise à terre est connectée au travers du cordon d'alimentation et le la prise AC au chargeur. Afin d'éviter les chocs électriques, branchez le cordon d'alimentation dans une prise correctement câblée et dont la terre a été préalablement vérifiée. Cette vérification doit être effectuée avant toute connexion de l'alimentation et de enregistreur numérique.

UTILISATION DU CORDON D'ALIMENTATION APPROPRIÉ

Si vous utiliser l'alimentation / chargeur, assurez-vous d'utiliser le cordon et le connecteur distribue avec l'alimentation (ou une cordon équivalent au sens des normes CEI). Utilisez uniquement un cordon en bon état.

REMPLACEMENT DES FUSIBLES

Afin d'éviter tout risque d'incendie, utilisez uniquement les fusibles spécifiés dans la section "*Maintenance & Service*" de ce manuel. Assurez vous que le type, la tension ainsi que le courant limite correspondent. Les fusibles doivent être remplacés par un technicien qualifié, et il faut s'assurer que l'instrument est complètement débranché de toute source d'alimentation *avant* de toucher aux fusible.

CÂBLAGE ET MISE À LA TERRE DES CAPTEURS

Pour les installation où les capteurs sont installés à distance du Enregistreur, et dans le cas où les capteurs et le Enregistreur sont mis à la terre localement, il est important de s'assurer que toutes les parties sont mises à terre au même potentiel. Des courants fatals dans les câbles de connexion peuvent résulter d'une mauvaise installation.

NE PAS UTILISER EN ATMOSPHÈRE EXPLOSIVE

Le Enregistreur et sont alimentation NE COMPRENNENT PAS DE PROTECTION CONTRE LES EXPLOSIONS contre les décharges statiques ou contre les composants pouvant provoquer des arcs. NE PAS utiliser ces composants en présence de gaz explosifs.

1. Getting Started

启动

Overview 总论

This *User's Guide* contains instructions and information pertaining to both the Altus K2 and Makalu (formerly known as the Everest) digital recorders, however there are certain significant differences between them. In order to make this information as clear as possible, the core of this manual is written in reference to the K2. All instances where the Makalu differs from the K2 are clearly identified and those differences are specified in detail.

本使用指南包含关于 Altus K2 和 Makalu(以前已知为 Everest)数字记录器两者的指示和信息，当然它们之间是有些显著差异的。为了使信息尽可能的清晰，参考 K2 编写了本手册的核心。在 Makalu 不同于 K2 的地方所有实例都被清楚指明，并且详细地阐述了那些差异。

Chapters 1 and 2 describe how to install a recorder with several peripheral instruments and devices. Chapter 3 describes the configuration and operation of the instruments. Chapter 4 describes the recommended maintenance and service of recorders. Chapter 5 provides a technical system overview as well as a summarized description of overall operation. Chapter 6 discusses advanced installation procedures.

第 1 和第 2 章叙述了如何安装记录器与几种外围仪器和装置。第 3 章叙述了仪器的设置和操作。第 4 章叙述了推荐的记录器的维护和服务。第 5 章提供了技术系统总览以及全部运行的综合说明。第 6 章则讨论了高级的安装程序。

The included *QuickTalk & QuickLook Software User's Guide* provides instructions for use of the QuickTalk & QuickLook software interfaces.

包括了 QuickTalk & QuickLook 软件的使用指南提供对于 QuickTalk & QuickLook 软件界面的使用指引。

Note: Users who wish to develop their own software to retrieve data from and control their recorders should be sure they have the latest versions of the *Altus Block Mode Communication* manual (Doc. 302218) and the *Terminal Mode Communication* manual (Doc. 302219). Contact Kinemetrics for this documentation.

注释：期望开发从记录器回收数据并控制记录器的用户应该肯定要有 Altus Block Mode Communication 手册(Doc.302218)和 Terminal Mode Communication 手册(Doc.302219)的最新版本。若须此文件则可与 Kinemetrics 公司联系。

The following manuals might also be included in this binder, depending on the recorder options purchased:

下列手册或许也包含在本文件夹里，这取决于所购买的记录器选项：

- The *Altus GPS Timing Systems User's Guide*, Doc. 302205 (the six-channel Makalu does not accommodate an external GPS option at this time) (外接 GPS 选项在 6 通道 Makalu 上不适用)
- *Altus Gain Board Operation Instructions*, Doc. 302206
- *Altus Block Mode Communications Manual*, Doc. 302218
- *Terminal Mode Communications Manual*, Doc. 302219
- *EpiSensor User Guide*, Doc. 301900

Kinemetrics is committed to ensuring a successful installation. For assistance with planning, installation, operation or maintenance for a recorder installation, please contact us. Kinemetrics also has an extensive Services Group that can install and maintain instruments and analyze data.

Kinemetrics 公司有责任使仪器安装必然成功。若需本公司协助对记录器安装进行计划、架设、操作或维护，请接触我们。Kinemetrics 公司也还有一个全面的服务组织，她能够为用户安装和维护仪器并分析数据。

For technical questions and assistance, please e-mail support@kmi.com.

要有技术问题和希望帮助，请电邮 support@kmi.com。

Note: Although this manual describes some basic preventive maintenance, it is not intended as a service or repair manual.

注：虽然本手册介绍了一些基础的预防维护知识，但不能算作是一本服务或修理手册。

Introduction 概述

The Kinemetrics K2 is a self-contained, four-channel (optionally, six- or 12-channel) digital recorder. When configured as an accelerometer, it typically

includes an internal triaxial force-balance accelerometer (EpiSensor) and a built-in GPS timing system.

Kinometrics 公司的 K2 仪器是一个自包容的 4-通道(可选 6-或 12-通道)数字记录器。当配置作加速度仪用时,它典型地包含一个内置三轴向力平衡式加速度计和一个内置 GPS 时间系统。

The Kinometrics Makalu digital recorder features a three-channel, 24-bit ADC/DSP board that offers approximately 129 dB of dynamic range at 200 sps. The dynamic range increases as the sample rate is decreased.

Kinometrics 公司的 Makalu 仪器具备了在 200sps 时提供动态范围大约 129dB 的 3-通道、24-bitADC/DSP 板的特性。在采样率减少时动态范围增大。

The Makalu is available as a three- or six-channel recorder only and is not offered with an internal accelerometer. It functions as a 3- or 6-channel seismological or strong motion recorder.

Makalu 不提供内置加速度计,仅可能作 3-或 6-通道记录器用。它可作为 3-或 6-通道地震或强震动记录器使用。

In general terms, a recorder functions in this way: as the sensors pick up ground acceleration or velocity signals, the recorder continuously monitors those signals to see if they satisfy seismic-event-detection criteria. When the signals satisfy these criteria, the recorder stores them as event data on a PCMCIA card for later retrieval.

一般说,在这里记录器运行:作为传感器拾取场地加速度或速度信号,同时记录器连续监测那些信号以注意它们是否满足地震事件判定标准。当该信号满足这些准则,记录器即将它们作为事件数据存储在 PCMCIA 卡上以备过后回收。

Event data can be retrieved remotely via modem or telemetry, or by a visit to the recorder site. The recorder can also transmit a continuous stream of digital data in real time.

事件数据可经由调制解调器或遥测技术远程回收,或者到记录器所在现场访问回收。该记录器也能够实时传输连续的数字数据流。

To set-up and retrieve data requires an IBM-compatible PC running Windows 2000, Windows NT 4.0, Windows 98 or Windows ME. For your convenience, the programs will also run under Windows 95 or 3.1

为了设置和回收数据需要配置运行 Windows2000,Windows NT 4.0,Windows 98,或 Windows ME 的 IBM 兼容的 PC 计算机。为使您便利,该程序也可在 Windows 95 或 3.1 之下运行。

This avoids the expense of a specialized dedicated playback system.

这免去了专用回放系统的费用。

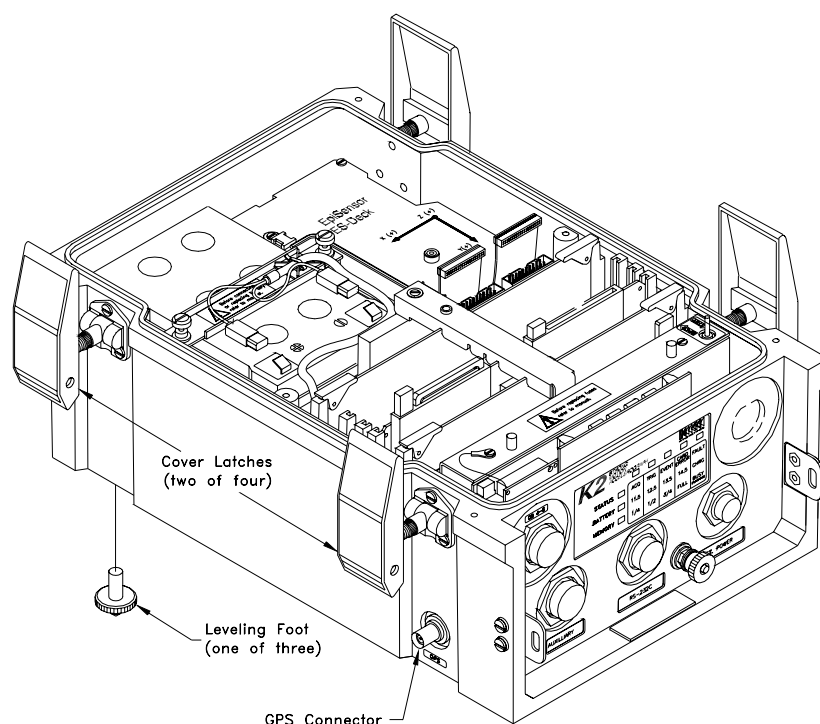
Typically, the watertight case contains the following components:

典型地，防水密封外盒包含下列部件：

- System electronics 系统电子器件
- PCMCIA data storage modules which conform to Personal Computer Memory Card International Association standards (PC card) PCMCIA 数据存储模块(PC 卡)
- A battery 电池
- EpiSensors (optional on the K2 and unavailable on the Makalu)
EpiSensor (在 K2 上可选，在 Makalu 上不能用)

These components are illustrated in Figure 1, which shows a typical K2 with the cover open. 这些部件显示在图 1 里，图 1 示出了典型的打开了盖的 K2 仪器。

Note: Please read the *Inspecting the Recorder* section of this chapter before



unpacking and examining the recorder. 注：在拆包和检查记录器之前请读本章检查记录器一节。

Figure 1: K2 with its cover off

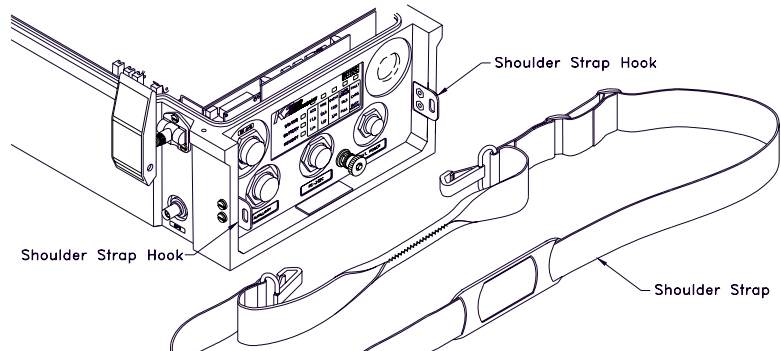
图 1 打开盖的 K2

An optional shoulder strap may be purchased, which allows the unit to be carried to remote field locations on foot. Figure 2 shows the strap and the shoulder strap hooks to which it attaches.

可以购买肩带选件，这样可方便地将仪器背到偏远野外现场。图 2 示出了肩带和所附的挂钩。

Figure 2: Shoulder strap and hooks (optional)

图 2 肩带和挂钩（选件）



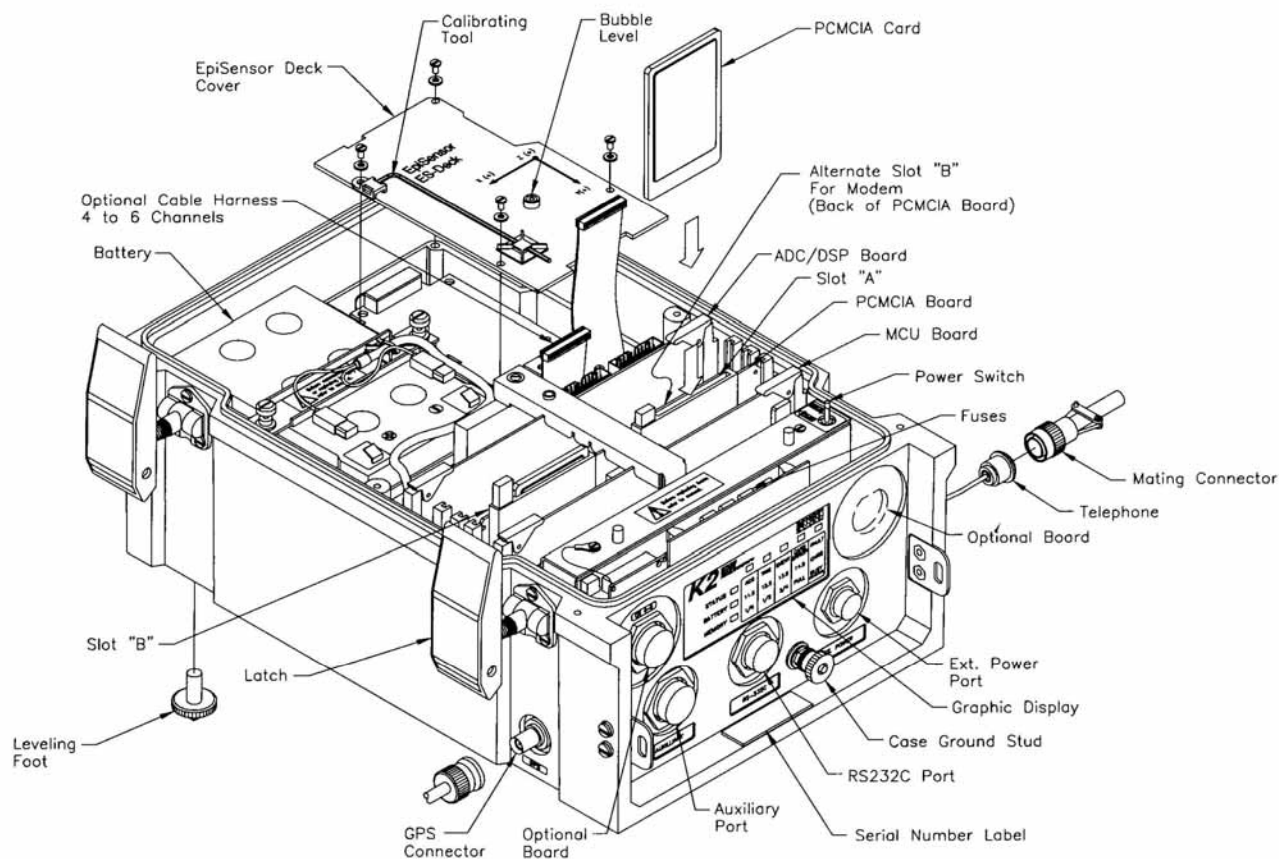
The Kinemetrics PSA (power supply assembly) option is normally supplied with the unit. Kinemetrics 公司的 PSD(供电装置)选项一般随记录器一起提供。

Caution: Potential equipment damage. Read through the rest of these instructions and those in the Safety section before plugging the power supply into the AC mains.

告诫：潜在的设备损害。 在将仪器接上 AC 主电源之前请读遍本处和安全章节的余下的指引。

Figure 3: Inside the K2

图 3 K2 的内部



A typical K2 contains the following elements:

典型的 K2 包括如下部件：

- Telephone or ISDN: Internal PCMCIA modem connection.
电话或 ISDN：内置 PCMCIA 调制解调器连接。
- Power Switch: Toggle switch that either turns the K2 on or to a standby state. Its two possible positions are labeled OPER and STBY. In OPER mode, the power is applied to all circuitry; in STBY mode, the power is disconnected from most electronics, but still flows to some critical time-keeping circuits. Power to the K2 is not truly turned off unless all power sources are disconnected.

电源开关：拨动开关，不是接通 K2 就是待机状态。这两个可能的位置相应地标志为 OPER 或 STBY。在 OPER 模式时，电源向所有电路供电；在 STBY 模式时，对多数电子电路切断供电，祇

仍然对一些紧要的时间保持回路供电。除非所有供电源都切断，否则 K2 的供电是没有真正被切断的。

- Optional Board (one of two): Additional external input board for sensor inputs or the extended GPS system interface.

选择板(两块之一)：为传感器输入或扩展的 GPS 系统板的附加外输入板。

- External Power Port (labeled EXT. POWER): Where external power sources plug into the recorder.

外接电源口(标记为 EXT.POWER)：外电源接入记录器的地方。

- Fuses: Protect the K2 from electrical overloads.

熔断丝：K2 的电力过载保护。

- Graphic Display: Eight LEDs and their labels provide visual information about the status of the K2, its battery, the power-supply, and the available memory storage space.

图形显示：8 个 LED 发光二极管和对应标签提供关于 K2、电池、供电及可用存储空间的可视信息。

- Case Grounding Stud: Connects the K2 to a good earth ground to protect against ESD (electrostatic discharge) and lightning-induced transients, and ensure low-noise performance.

机壳接地螺栓：连接 K2 至一个接地良好的场地，以做到抗 ESD(静电释放)和瞬间闪电感应，并保证低噪声性能。

- RS-232 Port: Connects the recorder to a PC via an RS-232 cable (P/N 109475).

RS-232 口：用 RS-232 电缆(P/N109475)将记录器连接到 PC 计算机。

- Auxiliary Port: Access to one of several input/output connections to provide advanced features.

辅助口：有权使用几种输入/输出连接之一以提供高级特性。

- Optional Board(s): An external input connector or an extended EPS board can be installed in one of the two optional board positions. External sensors connect to the K2 through an optional external sensor I/O board.

选择板：一个外接输入连接器或一个扩展 EPS 板，能够被安装在两个选择板位置之一。

- The GPS connector allows a GPS antenna to be plugged into the K2 to provide an accurate timing signal.

GPS 连接器允许将 GPS 天线插进 K2 以提供精确时间信号。

- Micro-Controller Unit (MCU) Board: Receives data from the system's sensors via the ADC/DSP (analog-to-digital converter/digital signal

processor), and decides whether the PCMCIA board should store that data. The MCU board also controls all interactions with the K2's communication ports.

微控制单元板(MCU)：经由 ADC/DSP(模数转换器/数字信号处理器)从系统的传感器接收数据，并决定 PCMCIA 板是否存储该数据。MCU 板也还控制与 K2 通信口的所有相互作用。

- PCMCIA Board: Contains interface electronics for the PCMCIA slots (A, B or alternate B, mentioned below).

PCMCIA 板：包含 PCMCIA 槽口(A,B 或替换的 B，下面提及)的接口电子电路。

- Slot A (and B): PCMCIA slots for the SanDisks (or PCMCIA hardware) on which the recorder saves event data. Data is saved until you retrieve and delete it.

槽口 A(和 B)：为 SanDisks 卡(或 PCMCIA 卡)用的 PCMCIA 槽口。记录器保存事件数据在 PCMCIA 卡上。

- Alternate Slot B: An optional PCMCIA modem can be installed in this slot (in which case Slot B should not contain a data storage module).

替换槽口 B：一个可选用的 PCMCIA 调制解调器能够被安装在这个槽口里(在这种情况下，槽口 B 应不包含一个数据模块)。

- ADC/DSP (analog-to-digital converter/digital signal processor) Board: Digitizes analog signals from the sensors and processes them before sending data to the MCU board. Optional gain board(s) attach here.

ADC/DSP(模数转换器/数字信号处理器)板：数字化从传感器来的模拟信号，并在输送数据到 MCU 板之前将它们处理。可选的增益板隶属此处。

- Optional Cable Harness: Connects to an internal EpiSensor deck (K2s only) or to an external input connector at one end, and to a connector on one of the ADC/DSP boards at the other end. Each harness can carry three channels of analog data into the K2. With the proper fittings, up to four triaxial EpiSensors or seismometers can be connected to the same K2.

选择的成套电缆：一端连接内置 EpiSensor 装置(仅对 K2)或一个外接输入连接器，另一端与 ADC/DSP 板之一上的连接器连接。每一个套具 harness 可令三个通道模拟数据进入 K2。用适当的装置，可使多到 4 台三轴向 EpiSensor 或地震计与同样的 K2 连接。

- Bubble Level, Calibrating Tool and EpiSensor Deck Cover: The deck cover prevents dust and other particles from contaminating the internal EpiSensor and the bubble level and calibrating tool are used for zero adjustment. (The Makalu has no bubble level or deck cover because it does not use internal EpiSensors. Gain boards in the Makalu are installed in this location.

气泡水准器、校准工具和 EpiSensor 装置盖：装置盖是为防止尘埃和其他微粒污染内置 EpiSensor，气泡水准器和校准工具是用于零位调节。（Makalu 没有气泡水准器或装置盖，因为它不用内置 EpiSensor。在里增益板安装在这个位置。）

Caution: Potential performance degradation. The EpiSensor deck cover provides grounding for the EpiSensor deck. Make sure it is attached during normal operation for the lowest noise performance.

告诫：潜在性能降级。 EpiSensor 装置盖提供该装置的接地。当适合于低噪声性能正常运行时请确认接地良好。

- Battery: Provides approximately 30 hours of power if the AC mains supply is interrupted or fails.

电池：若 AC 主电源中断或失效，仪器内电池可供电约 30 小时。

Note: Actual power autonomy is dependent on the options installed.

注释：实际功率自治权取决于被安装的选项。

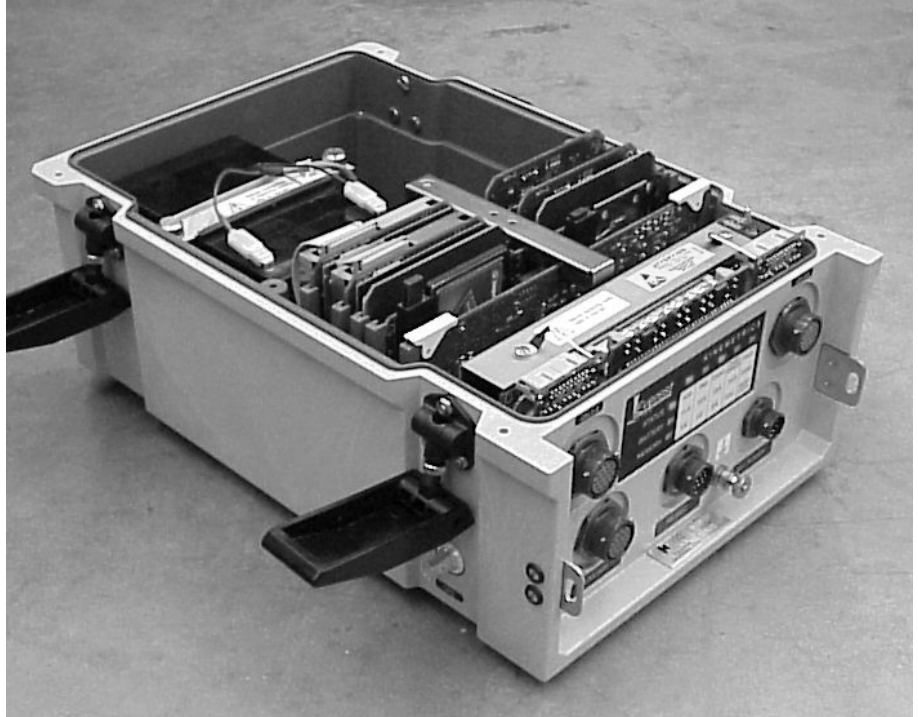
The Makalu

The Makalu is similar to the K2 in both function and appearance. The photo below shows a 6-channel Makalu. The ADC/DSP boards are different and there is a plug-in PCB shield installed in the third slot of the card cage.

Makalu 在外观和功能上都与 K2 相似。下面的照片示出一个 6-通道 Makalu。ADC/DSP 板是不同的，并且有一个插入式 PCB 屏蔽被安装在卡盒的第三槽口内。

Figure 4: 6-channel Makalu recorder

图 4 6-通道 Makalu 记录器



DIFFERENCES BETWEEN THE MAKALU & K2

Makalu 和 K2 间的不同之处

- Data is recorded to full 24-bit precision. The least significant bit (LSB) is not used as a clip indicator. The clip indicator has been moved to the frame header. New versions of the support software support this change.

数据是以完整 24-位精度记录。不用最低有效位(LSB)作为限幅指示器。限幅指示器已从帧头段除去。支持软件的新版本支持了这个改变。

- The input full-scale range is 40Vp-p (+/- 10V differential, each side). This range is compatible with external EpiSensors with the low-noise post-amp configured for high gain and differential operation. Other broadband sensors and seismic recording instrument manufacturers also support this range.

输入满量程是 40Vp-p(+/-10V 差分，每边)。这个量程是与具有低噪声后放大设置为了高增益和差分运行用的外接 EpiSensor 兼容的。另外一些宽带传感器和地震记录仪器制造业者也支持这个量程。

- Either one or two Makalu 3-channel, 24-bit ADC/DSP boards can be installed in the card cage. A plug-in shield board is installed in the third slot in the card cage to reduce system-induced noise.

任何一个或两个 Makalu 3-通道、24 位 ADC/DSP 板能装在卡盒中。一个插入式屏蔽板则装在卡盒的第三槽口里以减少系统感应噪声。

- The Makalu can be used with gain boards. They are installed in the location reserved for EpiSensors in the K2.

Makalu 能装增益板用。增益板是装在 K2 里为 EpiSensor 保留的位置。

- The 4th channel ADC input is not available via the Auxiliary connector. The Makalu ADC/DSP board is based on a 3-channel configuration

经过辅助连接器不可能作为第 4 通道 ADC 输入的。Makalu ADC/DSP 是基于 3-通道配置的。

- The ADC section is fully isolated to mitigate system-level grounding problems

为减轻系统级的接地问题，ADC 部分是被完全隔离的。

- Internal EpiSensor decks and PCMCIA hard drives are not offered due to the increased dynamic range of the recorder

由于增加记录器的动态范围，记录器不再提供内置 EpiSensor 装置和 PCMCIA 硬驱。

- The External GPS Option is currently not offered in the 6-channel version. The connector location normally reserved for this feature is used for channels 4-6

在 6-通道的情况下，一般不提供外接 GPS 选项。

- Other than the 40Vp-p input, all other characteristics of the I/O connectors are identical to the K2

除了 40Vp-p 输入外，I/O 连接器的其它特性都与 K2 相同。

- A *Calibrate* command has been added to the DG menu; however, this is intended for factory use only. Do not use the *Calibrate* command. There are sufficient chances to cancel the command if it is inadvertently issued. This command allows firmware calibration to 0.1% accuracy of ADC span.

校准命令已经加进 DG 菜单，不过这只是为工厂使用而设置的。请不要使用校准命令。

OPTIMIZING MAKALU PERFORMANCE 优化 MAKALU 的性能

Kinemetrics suggests that an AQ OFF/AQ ON sequence be issued after the Makalu has been allowed to stabilize its internal temperature and well after GPS has been acquired. This will establish the zero-level of the ADC to the best value possible — typically less than 500 μ V.

Kinemetrics 公司建议在允许 Makalu 稳定它的内部温度和 GPS 已经很好之后，发布 AQ OFF/AQ ON 序列。这将使 ADC 的零位水准认定为可能最佳值——典型地小于 500 μ V。

In order to achieve the best timing accuracy, we also strongly recommend that the GPS receiver be left on continuously.

为了获得最佳的时间精度，我们也强烈地建议 GPS 接收器保持连续工作。

Inspecting the Recorder 观察、检查记录器

Inspect the recorder as follows: 检查记录器如下：

1. Look at Figures 1-3 to familiarize yourself with the recorder. 观看图 1-3，以使你熟悉记录器。
2. Carefully remove the recorder from its shipping container. Save the container and packing materials if the recorder will be shipped further. 小心地从运输包装箱中移出记录器。保留包装箱和包装材料以备将来运输再用。
3. Open the four flip-up latches. 打开仪器盒盖的四个上翻锁扣。

4. Carefully remove the cover. 小心地移去上盖。
5. Visually compare the recorder contents with the drawings, inspect the components for obvious damage such as loose screws, bent metalwork, and so on. 用图对照观察比较记录器内部，检查是否有明显损伤的部件诸如螺丝松动、金属构件歪斜等等。
6. Make sure the PCMCIA card or cards are properly seated. The PCMCIA slots are in the front third of the recorder's interior, and the cards should already be in the slots with the card-release buttons sticking up above the slots. The card-release buttons should be in the up (or "filled") position. 确证 PCMCIA 卡或另外的卡都已适当固定。PCMCIA 槽口是记录器内部前数第三个槽口，并且卡已装入槽内，卡的释放按钮处于槽口上方，这时卡的释放按钮应在向上的(或“被填充”)位置。

If the recorder is equipped with an internal PCMCIA modem, it will be in "Alternate slot B" on the rear of the PCMCIA board. There will be a label in slot B warning you not to insert a PCMCIA card. 若记录器装有内置 PCMCIA 调制解调器，该 modem 则应置于 PCMCIA 板背面上“替换槽口 B”内。这时在槽口 B 内将会有有一个标志警告你不能置入 PCMCIA 卡。

Handling Precautions 预防触摸危险



Caution: Potential ESD equipment damage. The recorder circuit boards contain CMOS components that can be damaged by electrostatic discharge (ESD) if not properly handled. Use a grounded wrist strap, with impedance of approximately 1 MΩ, to protect components from ESD damage when handling circuit boards. Before removing any circuit boards or disconnecting any internal cables, be sure that all batteries and the charger are disconnected.

告诫：潜在 ESD 设备损害。记录器电路板上含有 CMOS 元件，如果触摸不恰当，这些元件极易受到静电释放(ESD)损坏。戴上一个具有约 1M 电阻的接地腕带，在触碰电路板时可以保护元器件免受 ESD 危害。在移动任何电路板或拆下任何内部电缆之前，务须确证所有电池及充电器均被切断。

If there is no obvious damage, proceed with the installation instructions. Please work through the following section carefully so that the recorder installation will accomplish your scientific objectives. 若未见明显损坏，可按安装指示继续进行。请小心地干完下一节，就可完成记录器安装，实现你的科学目标。

Installation Considerations 安装需要考虑事项

This section discusses recording network setup and operating modes.

本节讨论记录网络设置和运行方式。

Network Planning 台网设计

Carefully consider the scientific objectives of the installation when planning the network, whether it includes one station or a hundred. 当做台网设计时，不论它是包含一台或是一百台都要谨慎考虑科学目标。

The station location, type and position of sensors, and instrument settings all affect the type of data recorded. Consider local seismic-noise conditions and the anticipated amplitude of events being recorded. This will help you correctly set trigger parameters, estimate the quantity of data expected, and decide how to retrieve the data. 台站地点、传感器型式和位置，及仪器设置全都影响记录数据的形式。应考虑当地地震噪声环境状况和有记录的事件的预期振幅。这将帮助你正确设置触发参数、估计预期数据的量值，以及决定如何回收数据。

It's also necessary to plan how to analyze, combine, and archive data, as well as how to service and maintain the network. Finally, consider how the network will function after a large event, when mains power and telecommunications might not be available for a considerable time. Under such circumstances, how do you plan to retrieve and process the network's data, as well as continue operating it? 设计如何对数据进行分析、联合和归档，以及如何服务和维护台网也都是必需的。最后，应考虑在大事件发生后致使主电源和电讯中断且会保持一段时间的情况下台网如何运行。在此境况下你将如何设计回收和处理台网的数据，以及继续运行台网。

Civil Engineering 土木工程

Before installing the recorder, plan and construct (if necessary) the housing that will provide a protective infrastructure for the unit. The exact details of the installation depend on local conditions, local regulations, and the purposes of the installation. 在安装记录器之前，设计和建造仪器柜室将为仪器提供一个保护的环境条件。仪器安装的准确详细资料依靠当地状况、地方规章，及安装的意图。

Except in cases of a rapid emergency deployment of seismic instruments, the recorder should be housed in a protective structure. Below are the two typical types of installation settings and related protective structures. They can be used as rough guidelines for an installation. 除地震仪器快速紧急布设的情况外，记录器均应装置在防护结构内。下面是安装设置和相关保护结构的两种典型方式。它们能被用作安装的粗略指引。

FREE-FIELD INSTALLATIONS 自由场的安装

In a free-field accelerograph installation, the recorder is installed some distance from buildings in a "free field" and sheltered by a small, lightweight structure that allows the internal EpiSensor to sense acceleration as close as possible to the "true" accelerations of ambient ground motion. In softer ground sites, because of the soil-structure interactions during earthquakes, a heavier-than-necessary protective structure could degrade data accuracy. 在自由场的加速度仪安装中，将记录器装置在离建筑物有一定距离的“自由场”并由一

个轻小结构防护，以保证内置 EpiSensor 拾取的加速度量尽可能地与周围环境“真实”的加速度接近。

The structure should also protect the recorder from weather, direct sunlight, and theft or vandalism. A "transformer hut" made of fiberglass and stainless steel hardware is ideal as long as it, and the recorder, are attached to a poured and reinforced concrete pad. If true hard-rock site response is desired, anchor this concrete pad to bedrock 该结构应该也能保护记录器免受来自各种天气、直射阳光，及偷盗或人为故意破坏等的干扰。如果以用玻璃纤维和不锈钢五金器件制造的“变压器小屋”作为此种结构，并且记录器是架设在一块现浇钢筋混凝土底板上则是理想的。若希望取得基岩场地的真实反应则应将此混凝土板与基岩锚固。

If you are using the recorder with broadband sensors, it must be placed in a seismic vault with a pier on which to mount the sensors. This vault will need to not only protect the instrument, as in the case of the free-field accelerograph, but also must provide a stable mounting structure and insulate the sensors from ambient temperature variations. It should be a low-noise site for optimal operation. Masts for antennas, GPS, wireless communication and solar cells should be mounted some distance from the sensor vault to prevent wind-induced noise from contaminating the data. Kinemetrics has several application notes that can help you install a broadband sensor network. 如果你将记录器与宽带传感器连用，则必须将其置于地震仪器地窖内，并且传感器应安置在仪器墩上。在自由场加速度仪的场合，这个地窖不只是用以保护仪器，还必须提供稳定的支架结构和隔离环境温度变化对传感器的影响。为了最理想的运行，它应是低噪声场地。天线、GPS、无线通信及太阳能电池板等的桅杆应离开传感器地窖一定距离，以防止风诱发噪声污染数据。Kinemetrics 公司有几份应用技术备忘资料可帮助你安装宽带传感器台网。

Provide the recorder with a good earth ground. Proper grounding depends greatly on the humidity of the soil at the site. For average-humidity soil, an effective earth ground can be made by wiring the case grounding stud to a 6'- to 8'-long copper rod embedded in the ground. 应提供记录器一个良好接地场所。正确的接地是极大地依赖于场地土壤湿度的。对于一般湿度的土壤，将仪器外盒接地线柱与一根埋入场地土内长约 6 英尺到 8 英尺的铜棒相连接即可获得有效地接地。

If no AC power is available, a solar charging system is required. Refer to the *Advanced Installations* section of this manual for more information. 如果不可能用 AC 供电，就需要用太阳能充电系统。可参考本手册里高级安装一节以得到更多信息。

If the recorder has a GPS system, the GPS antenna will need a suitable mounting mast. A telephone line or other communication link is required to communicate with the recorder remotely. 如果记录器带有 GPS 系统，则 GPS 天线将需要相匹配装置天线杆。为与远程记录器通信，则需要设有电话线或其它通信链路。

STRUCTURAL-MONITORING INSTALLATIONS 结构监测的安装

In a structural-monitoring installation, you provide protection to the recorder by installing it within an existing building or structure (a bridge, a dam, a high-rise, etc.). The main purpose for installing the recorder in an existing structure is to measure and monitor the structure's vibrations in response to ground motion. While some use such installations to calculate measurements of "free-field" seismic motions, the very nature of the structure's size and foundation depth cause the acceleration measurements to deviate considerably from "true free-field" response. 在结构监测的安装中，你可以将记录器安装在现有的建筑物或结构物(桥、坝、高从建筑物等)内以提供对记录器的保护。在现有建筑物里安装记录器的主要目的是测量和监测该建筑结构对地面运动的振动反应。虽然有些时候使用如此安装是为考虑“自由场”地震运动的测量，结构的大小和基础的深度是引起加速度测量相当地偏离“真实自由场”反应这是很自然的。

For a structural-monitoring installation, make sure the space in the structure allows enough room to mount and service the recorder, and that the space provides enough protection so the recorder and its sensors will not be disturbed or vandalized. Powering the recorder requires a mains supply close to the installation point. To connect a modem, a phone line is also necessary. 对于结构监测的安装，须确保在结构里要有足够的房屋空间以便安装和服务于记录器，以及提供足够保护记录器和传感器不受干扰和破坏的空间。记录器的供电要求主电源靠近安装点。为连接调制解调器，也需要一根电话线。

As for the recorder's optional GPS antenna, carefully plan to locate the antenna close enough to the recorder so the supplied GPS cable will reach between the two. 对于记录器选项的 GPS 天线，要精心设计将天线定位与记录器不能太远以使所提供的 GPS 电缆能满足两者的联接。

To use multiple EpiSensors mounted around the structure, make a detailed plan of the sensors' locations and plan how to run the cables between them and the recorder. To interconnect recorders, plan the layout of the interconnecting cables. If possible, run all the cables (sensor and interconnect) through grounded metal conduit. 为了使用在结构各处安装的多个 EpiSensor，要做传感器位置的详细设计，以及设计它们与记录器之间如何走线。为了互连记录器，需要设计互连电缆走线布置图。如果有可能，所有电缆(传感器和互连接)最好都穿过接地金属线管走线。

All these elements of an installation should be in place before the recorder itself is installed. 所有这些安装要素应该在记录器本身安装前到位。

Requirements for Installation 安装需 备条件

Below we provide lists of the tools, supplies and equipment required to install an entire recorder system in its typical configuration, including the recorder,

either an internal (in the case of a K2) or external EpiSensor, and a GPS timing system. 下面我们提供为安装完整的记录器系统所需的工具、补给品及设备列表。所谓的完整记录器系统其典型设置包括记录器、一个内置 EpiSensor (K2 场合) 或外接 EpiSensor, 以及一个 GPS 时间系统。

Specialized installations may require additional tools, supplies or equipment, depending on specific sites and needs. This manual assumes that all civil engineering works (concrete pads, enclosures, conduit, mounting masts, etc.) are complete and ready at the outset of the recorder installation. 专门的安装可能需要附加的工具、补给品及设备, 这取决于特殊的场地和需要。本手册假定所有土建工程工作 (混凝土板、封装围栏、管道管渠、装备桅杆等) 在记录器安装开始时已完成和准备完毕。

Required Tools 必需的工具

FOR THE RECORDER 用于记录器的

The recorder must be rigidly mounted to the floor of its structure or enclosure. The supplied mounting kit (P/N 700170-02) includes a 1/4-20 anchor stud with an attached concrete anchor, a sealing washer, a flat washer and a nut. 记录器必须牢固地安装在结构或仪器柜室的地板上。所提供的安装套件 (P/N700170-02) 包含一根带有混凝土锚定的 1/4-20 锚着螺栓、一个密封垫圈、一个平面垫圈及一个螺母。

The following tools are required: 下列工具是必需的:

- A concrete drill with a 1/4" (6.4 mm) diameter 4" (10 cm) long masonry/concrete bit. 带有一根 1/4"(6.4mm)直径、4"(10cm)长的砖石/混凝土钻头的混凝土钻孔机。
- A 7/16" (11 mm) wrench to tighten the nut on to the anchor stud. 一把 7/16"(11mm)扳手以将螺母拧紧到锚着螺栓上。

FOR THE GPS TIMING SYSTEM 用于 GPS 时间系统的

Both internal and external GPS systems require the following tools for installation: 为安装内置或外接 GPS 系统需要下列工具:

- Wrench or pliers to tighten the Type F connector on the GPS bullet antenna 扳手或钳子用以拧紧 GPS 子弹头天线上的 F 型连接器
- Tools for mounting the antenna 安装天线的工具
- A heat gun (electric or butane) 一把加热枪(电的或丁烷气的)

An external GPS system installation requires the following additional tools: 对外接 GPS 系统安装还需下列附加工具:

- Soldering iron (electric or butane) 烙铁(电的或丁烷气的)
- Small screwdriver 小螺丝起子
- Wire cutters 割线刀具(电工刀)
- Wire strippers 剥线器
- Long-nose pliers 长鼻钳 (尖嘴钳)
- Utility knife 通用刀

- A drill (electric or battery powered) 钻孔器(电的或电池供电的)
- Cable tie wraps 电缆捆绑包装的线、带或套管
- A crimping tool 卷边器
- A short length of insulated braid 短的绝缘编织带
- An extension cord or a small generator for AC power, if butane-powered soldering irons and battery-powered drills are not available 一条加长的电源线缆或一台小交流发电机（当丁烷气烙铁和电池供电钻孔器不能提供时）

FOR AN EXTERNAL EpiSENSOR 用于外接 EpiSENSOR 传感器的

Refer to the *EpiSensor ES-T User Guide*. It details the tools and equipment required for making a cable to connect the EpiSensor to the recorder and provides instructions about how to mount the sensor. 参考 EpiSensor ES-T 使用指南。它详细阐述了制做一根连接 EpiSensor 与记录器的电缆所需要的工具和提供了关于如何安装传感器的指引。

Required Supplies 必需的补给品

- Material to make grounding straps for the recorder 制作记录器接地带的材料
- Solder with rosin-core flux 具有松香焊剂内芯的焊条
- An assortment of heat-shrink tubing, cable tie-wraps, and electrical tape 各种规格加热收缩管状电缆绑套和电线绝缘带

Required Equipment 必需的设备器材

- An IBM-compatible portable/laptop PC 一台 IBM 兼容便携/膝上型 PC 电脑
- A portable printer, to print tests and other commissioning data 一台便携式打印机，以供打印试验和其它试运行数据
- Kinometrics' RS-232C cable to link a PC to the recorder 一根 Kinometrics 的 RS-232 电缆，以供 PC 机与记录器链接
- A battery-powered digital volt meter (DVM) to adjust the zero-level of the EpiSensor and other system-checkout functions 一块电池供电的数字电压表(DVM)，以供调节 EpiSensor 的零位水平和其他系统校验功能
- A compass, to check the orientation of the sensors 一块罗盘，以供检查传感器的方位
- A camera, to photograph the completed installations for the commissioning report 一台照相机，以提供时运行报告需用的全部安装实况照片

Practice Assembly 实际集合演练

Once you have assembled the tools, supplies, and equipment listed above, we recommend that you run through a practice assembly following the installation instructions. 一旦你已经装备了上面所列工具、补给品及设备，我们建议你先按照下列安装指引从头到尾运行一次实际集合演练。

Why Practice In the Laboratory? 为何要在实验室内演练？

The connections between all the components mentioned in this manual may appear a bit complex. They will be even more complex if your first installation attempt is in a remote field situation where you find that you lack the necessary tools, supplies, or equipment to make the connections work. 本手册中所提及的所有部件之间的连接可能会出现小的麻烦。如果你初次安装尝试就在一个偏远的野外场合，在那里你可能会发现你会缺乏一些必需的工具、补给品及设备去做连接工作，这甚至将会有更大的麻烦。

Practice in a well-supplied, well-lit laboratory or office when first connecting a PC, GPS, and modem systems to the Kinometrics equipment. Follow these instructions carefully, step by step, to learn exactly which tools, supplies and equipment will be needed in the field. 当初次将 PC 机、GPS 及调制解调器系统与 Kinometrics 的设备相联接时，请在补给、光线条件好的实验室或办公室内进行实践。小心地跟着这些指引，一步一步地，学习如何正确地使用那些在现场将需用的工具、补给品及设备。

Murphy's Law provides a further reason for a practice installation: *If anything can go wrong, it will*; and Isaac's Corollary: *Murphy was an optimist!* 墨菲定律为实践安装提供了一个更深一层的理由：*如果任何事可能出错，它也将会，并且艾萨克推论：墨菲是个乐天派。*

For the practice assembly, follow the instructions in Chapter 2. 请跟随第二章里的指引进行实际集合演练。

2. Installation Basics 安装基础

Overview 总论

This chapter explains several common installation procedures as well as relevant operational concepts. For specific instructions about more complex installation procedures, see Chapter 6 of this manual. 本章阐述了几个普通安装程序以及相关操作概念。关于更复杂的安装程序的专门指引请参见本手册第 6 章。



Caution: Potential electrostatic discharge (ESD) hazard to equipment.

Before removing any boards or internal connectors from the unit, put the OPER/STBY switch inside the unit in the STBY position and disconnect all batteries and chargers. Wear a grounded wrist strap with impedance of approximately 1 MΩ when handling boards to protect recorder components from damage.

告诫：危害设备的潜在静电释放(ESD)。在由记录器内移出任何板件或内部连接器之前，需将仪器内的 OPER/STBY 开关置于 STBY 位置，并且断开所有电池和充电器。戴上具有约 1M 电阻的接地挽带，以当摸碰板件时保护记录器部件免受损坏。

Before attempting to install the recorder in the field, we recommend that you practice the installation instructions in your office or laboratory.

试图在现场安装记录器之前，我们建议你宜在你的办公室或实验室里先做好安装指引的实践演练。

Installing the Basic Recorder 记录器 基本安装

Installing Support Software 安装支持软件

To set up and retrieve data from the recorder requires a computer equipped with either a commercial communication program such as ProComm,[®] HyperTerminal[®] or Kinemetrics' QuickTalk & QuickLook program supplied with your unit. 为了记录器设置和回收数据需要一台装备随便任一个商业通信软件如 ProComm[®]、HyperTerminal[®]或 Kinemetrics 的 QuickTalk 和 QuickLook 程序提供你的仪器用的计算机。

It is much easier to set up the instrument using QuickTalk and QuickLook. To install this software, refer to the *Installing the Software* section of the *QuickTalk and QuickLook Users Guide* that is included in the back of this binder. 用 QuickTalk 和 QuickLook 程序装配仪器是非常容易的。要安装这些软件请参考 *QuickTalk 和 QuickLook 程序使用指南* 的安装软件部分，该指南包含在本文件夹的后面。

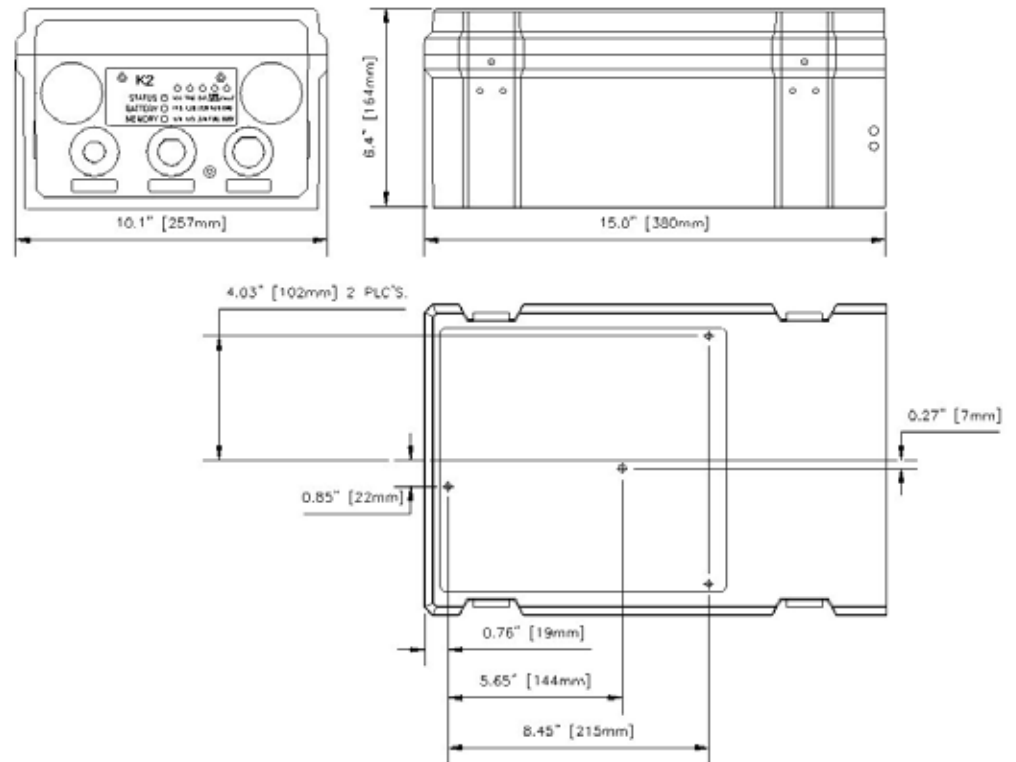
Orienting a Recorder with an Internal EpiSensor 内置 EpiSensor 摆记录器的定向

Determine which direction to orient the recorder: true north, or "aligned-with-structure." The orientation you choose will determine the coordinate system for recorded data. 确定记录器方位：真北、或“按结构主轴向排列”。你选定方位将确定记录数据的坐标系统。

Typically, the front panel of the recorder will face north, in which case the Y-axis will be aligned north. The coordinate system will then be consistent with standard external EpiSensor installations. 典型地，记录器的前面板将面向北方，在该场合 Y 轴将指向北方。这坐标系统将与标准外接 EpiSensor 安装相同。

Note: If you use a compass to determine the true north-south axis, make sure to correct for the difference between magnetic north indicated by the compass, and true north (magnetic declination). This deviation depends on your location; you can find the correct deviation on a local topographical map. 注释：如果你用罗盘确定真南北轴方位，需确实校正罗盘指示的磁北与真北之间的差异（磁偏角）。偏差取决于你的地点；你可以在当地的地形图上找到正确的磁偏角值。

If the instrument is installed in a structure, it is normally aligned parallel to the structure's main axis. If possible, keep the same orientation for all recorders installed in the same building. 如果在结构上安装仪器，一般都是沿平行结构的主轴方向设置仪器方位。如果可能，在同一建筑物中所有记录器都应保持同样的方位设置。

Figure 5: Mounting dimensions**图 5 安装尺寸**

Keep a permanent record of the orientation you choose, and of how and in relation to what the recorder is oriented. This information is crucial to the proper analysis of recorder data. 保存一个你选定方位和如何关系到记录器定位的永久记录。这信息对于正确分析记录器数据是至关重要的。

To place the recorder inside an existing structure, make sure the area is large enough and includes at least 8-10 inches (20–25cm) of working space on each side of the unit; see Figure 6. 为了在现有结构内放置记录器，需要落实仪器每边至少有 8-10 英寸(20-25cm)足够大的工作空间，参见图 6。

Allowing sufficient access space is crucial for the K2 because it has an internal sensor deck that may need to be accessed after installation. 允许充分的访问空间对于 K2 仪器是至关重要的，因为它有内置传感器装置在安装后可能需要访问。

Figure 6: K2 mounted with sufficient working space

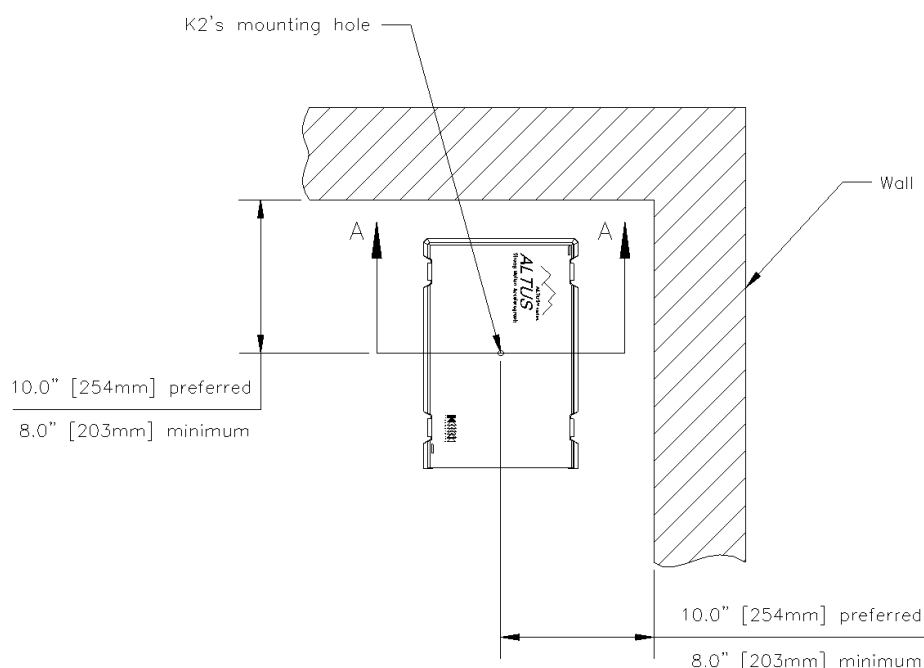


图 6 安装 K2 必需的最小工作空间

If the interior planned dimensions are large enough and the concrete pad is poured and prepared, you are ready to mount the recorder unit. 如果内部计划尺寸足够大并且混凝土板已灌筑准备好，你对安装记录器单元已准备完毕。

Mounting the Recorder 记录器固定

The next step is to decide how you are going to mount the recorder. This section explains the following mounting procedures: 下一步是决定你如何去固定记录器。本节阐述下列固定程序：

- Floor mounting (recommended for all recorders but required for K2s with an internal EpiSensor.) 地板固定（对于所有记录器都建议用此方式，对于具有内置 EpiSensor 的 K2 仪器则必须用此方式。）
- Shelf mounting 支架搁板固定
- Wall mounting 墙壁固定

Note: For K2s with internal EpiSensors, the unit must be securely coupled to the ground to accurately record ground motion. In units without sensors, secure the recorder in such a way that it will not fall off its mounting during the intense shaking of an earthquake.

注释：对于具有内置 EpiSensor 的 K2 仪器，必须安全牢靠地与地面连接以精确地记录地面运动。对于不带有传感器的记录器，只要能安全可靠地放置不至于在强烈地震时跌落即可。

The unit has a single hole in the base for a 1/4" (6.4 mm) bolt. To attach the recorder to the mounting surface, use the mounting kit shipped with the recorder. It includes a heavy-duty wedge type expansion anchor stud with 1/4-20 thread, a flat washer, a sealing washer, and a nut. The following figures show the details of such an installation. 仪器在底板上有一单孔以供 1/4"(6.4mm)螺栓用。用随记录器一起带来的固定套件将记录器固定在地表面上。该套件包含一根 1/4-20 螺纹的耐压楔型膨胀螺栓、一个平面垫圈、一个密封垫圈及一个螺帽。下列图示出了安装细节。

FLOOR-MOUNTING (RECOMMENDED) 地板固定（推荐）

Users with a K2 unit with an internal EpiSensor must mount the unit as described in this procedure. 对于具有内置 EpiSensor 的 K2 仪器的用户必须按本程序记述固定仪器。

Note: Leveling and orientation are not required for operation of recorders without internal sensors, but doing so will result in a more professional looking installation.

注释：对于不带有内置传感器的记录器是不需要找平和定方位的，不过这样做也无妨，可能看上去安装更专业些。

Anchor the recorder unit to a concrete floor if possible. Prepare the recorder for mounting as follows:

如果可能请将记录器单元锚定在混凝土地板上。准备记录器固定如下：

1. Be sure that each of the recorder's leveling feet are screwed into place.
一定做到每一个记录器找平脚都拧到位。
2. Remove the recorder's cover and set it aside.
打开记录器盖并放在旁边。



WARNING! Burn or fire hazard. Do not short the battery terminals with metallic conductors, such as a screwdriver or pliers. The battery can provide up to 80 amps of current. This amperage, when flowing through a non-isolated conductor, can result in very high temperatures and even fire.

Do not replace the supplied battery with a non-rechargeable battery or a battery that does not meet the requirements given in Chapter 4 in the *Replacing Batteries* section.

警告！燃烧或火灾。绝不用金属导体诸如螺丝起子或钳子短接电池两极。电池能够提供多到 80 安培电流。这样的安培数流过非绝缘导体时会产生非常高的温度甚至火灾。**绝不用非可充电电池或不满足第 4 章置换电池一节规定的电池去替换仪器电池。**

3. Disconnect the battery wires from the terminals, unscrew the internal battery bracket, and set the internal battery aside.

从电池两极断开电池接线，拧下内置电池压条并放在内置电池旁。

4. Remove the protective plug from the mounting hole on the recorder's underside. 移去在记录器底板上的安装固定用孔保护塞子。

5. Move the recorder gently to one side. 轻轻地移动记录器到一旁。

6. Locate where you plan to put the recorder, keeping in mind the working space dimensions in Figure 6. 在你计划设置记录器的地方定位，应注意符合图 6 中的工作空间大小。

7. Use a drill with a 1/4" (6.4 mm) bit, and drill into the concrete to a depth exceeding the maximum depth you intend for the anchor to penetrate, as shown in Figure 7. A percussion or hammer drill will make this procedure much easier. You should follow all recommended safety precautions when using power tools and we recommend you wear safety glasses during the installation procedure.

如图 7 所示，用带有 1/4"(6.4mm)钻头的钻孔机在混凝土垫板上钻孔，孔深应略超过你打算的锚着深度。用冲击钻可使钻孔非常容易。在使用动力工具时，你应该遵守所有建议的安全防范要求，并且我们建议你在这个安装程序中应戴安全玻璃面罩。

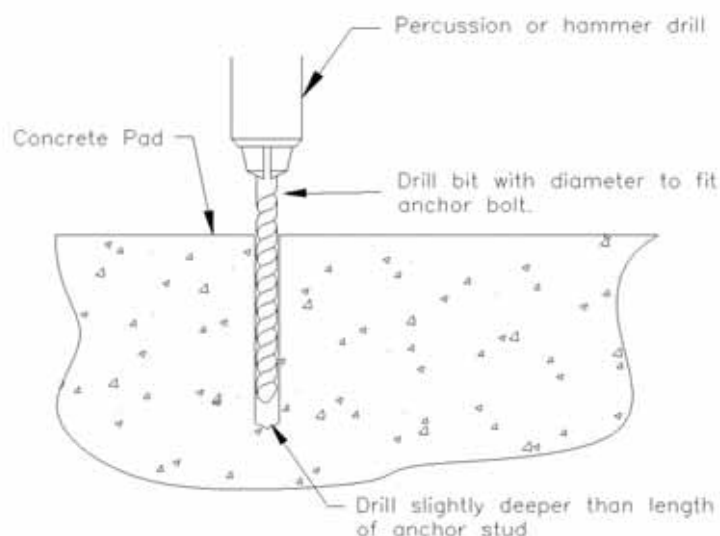
Figure 7: Drilling a hole for the anchor bolt

图 7 钻锚着螺栓用孔

8. Make sure you clean out the hole after drilling it. A flexible drinking straw makes a good tool for this. Make sure you don't blow dust in your eyes!

你在钻孔后应将孔清理干净。软吸管是很好的清孔工具。另外你要确保不让尘埃迷住你的眼睛！

9. Screw the nut onto the anchor bolt until the top of the nut is flush with the top of the anchor bolt, as shown in Figure 8.

如图 8 所示，拧螺母到螺杆上，直到螺母顶与螺杆顶齐平。

Note: It is very important not to damage the threads of the anchor bolt. Place a small piece of wood or similar object on top of the nut before tapping with the hammer. This will dissipate the energy between the bolt/nut and the hammerhead and avoid damage to the threads.

注释： 它对于不损坏螺杆的螺纹是十分重要的。在用锤子轻拍之前要放一小块木片或类似物品在螺母顶上。这将耗散一些螺杆/螺母与锤头之间的能量以避免螺纹的损坏。

10. **Gently** tap the anchor bolt assembly (anchor and nut) into the hole in the concrete pad. The recorder's leveling feet keep the unit off the floor, so you must leave approximately 2-1/4" (57.2mm) of the anchor bolt protruding from the hole.

将锚着螺杆集合(锚杆和螺母)轻轻地拍进混凝土垫板的孔中。由于记录器找平脚使记录器与地板保持一定间隙，所以你必须留有约 2-1/4" (57.2mm) 螺杆露出孔口。

11. Unscrew the nut from the top of the anchor. 由锚杆顶拧下螺母。
12. Center the recorder over the anchor and lower its mounting hole down over the protruding bolt. 将记录器底板孔与出露的锚杆对中并放下。

13. Apply silicon lubricant to the sealing washer and carefully screw it onto the bolt without damaging the rubber seal. Then place the flat washer onto the bolt. Then screw the nut onto the bolt. Tighten the nut so that it is about 1/8" (3.2mm) from the bottom of the case.

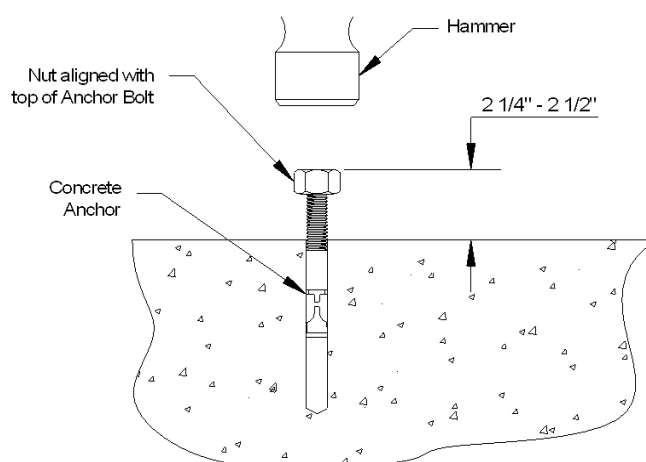
用硅润滑剂涂密封垫圈使其仔细地拧上螺杆不可对橡皮封圈有损坏。然后放置平面垫圈到螺杆上。再把螺母拧到螺杆上。拧紧螺母使其离仪器盒底约为 1/8"(3.2mm)。

Caution: Potential equipment damage from moisture. Use the sealing washer to stop moisture from getting into the unit. Leave the desiccant packet inside the recorder to keep it free of humidity damage for a normal maintenance period.

告诫：潜在设备受潮损坏。用密封垫圈是为了隔绝潮湿侵入仪器。留下干燥剂小袋于记录器内以保持其在一个正常维护周期内免受潮湿损坏。

Figure 8: Driving the anchor bolt and nut into the hole

图 8 将锚着螺杆和螺帽置入钻孔中



14. Make sure the recorder is oriented in the correct direction and leveled before you proceed with Step 15.

在继续按第 15 步办法进行记录器找平之前，确使记录器定方位在正确的方向上。

15. Look at the bubble level window while you carefully screw each of the recorder's three leveling feet (shown in Figure 3) in or out. When you can see the air bubble centered in the bubble level window with all three leveling feet resting on the mounting pad, the recorder is leveled.

在你仔细调进或调出记录器三个找平脚的每个脚的同时，观察气泡水准窗（示于图 3）。当你看到气泡在气泡水准窗里居中时，使三个找平脚静止在安装垫板上，这时记录器被找平。

16. Carefully maintain both the recorder's level and its orientation as you tighten down the anchor nut to hold the recorder firmly in place. This final tightening should force the concrete anchor to expand inside the hole and lock the unit in place. Use a torque of 80-100 inch-lbs (902 – 10.2nm) to tighten the nut.

在你向下拧紧锚杆螺母以保持记录器稳固在适当位置同时，必须小心地维持记录器的水平和它的方位。最终的紧固应迫使混凝土锚定在孔里面膨胀开，紧锁仪器在适当的位置。使用 80-100 英寸-磅(9.02-10.2nm)扭矩的力量拧紧螺母。



WARNING! Burn or fire hazard. Do not short battery terminals with metallic conductors, such as a screwdriver or pliers. The battery can provide up to 80 amps of current. This amperage, when flowing through a non-isolated conductor, can result in very high temperatures and even fire. **Do not** replace the supplied battery with a non-rechargeable battery or a battery that does not meet the requirements in the Replacing Batteries section.

警告！燃烧或火灾。绝不用金属导体诸如螺丝起子或钳子短接电池两极。电池能够提供多到 80 安培电流。这样的安培数流过非绝缘导体时会产生非常高的温度甚至火灾。**绝不用**非可充电电池或不满足在置换电池章节规定的电池去替换仪器电池。

17. Replace the internal battery. Be sure that the rubber battery pad is under the battery. Screw the battery bracket back into place and reconnect the black wire to the negative terminal of the battery.

Do not connect the red wire until told to do so later.

置换内置电池。确证橡皮电池垫片是在电池之下。拧动电池压条置回原处，并重接黑线到电池负极。直到稍后告诉你之前，**绝不能**连接红线。

Caution: Potential performance degradation. The EpiSensor deck cover provides grounding for the EpiSensor deck. Make sure it is attached during normal operation for the lowest noise performance.

告诫：潜在性能降级。EpiSensor 装置盖提供该装置的接地。当适合于低噪声性能正常运行时请确认接地良好。

The mounting procedure described above is recommended by Kinometrics. If your recorder **does not have** an internal EpiSensor, it is possible to use the two mounting methods described below. **Do not use** these methods if your K2 has an internal EpiSensor.

上述固定程序是由 Kinometrics 公司建议的。如果你的记录器没有内置 EpiSensor,则也可用下述两种固定方法。如果你的 K2 有内置 EpiSensor , 则绝不可用这两种方法。

SHELF-MOUNTING 支架搁板固定

If the recorder **does not have** an internal EpiSensor, it can be mounted on a shelf as follows:

如果记录器没有内置 EpiSensor , 它可固定在支架搁板上如下 :

1. Unscrew the leveling feet from the bottom of the recorder and remove.
从记录器底部拧松找平脚并移去。
2. Insert plastic wall anchors into the three threaded holes in the bottom of the unit. 将塑料墙锚栓嵌入记录器的三个螺纹孔内。
3. Match and mark the positions of the threaded holes on the bottom of the shelf on which you intend to mount the recorder.
在你打算要安装固定记录器的支架搁板上相配和标注螺纹孔的位置。
4. Screw three sheet-metal screws from the bottom of the shelf up through the shelf until they protrude.
从支架搁板底部向上拧三个薄片金属螺钉穿透搁板直到露出。
5. Place the recorder so the threaded holes are over the screw tips, and then tighten screws up into the plastic wall anchors. 放置记录器让螺纹孔正在螺钉尖上, 然后向上拧紧螺钉进入塑料墙锚栓内。

Alternately, on a thicker shelf: 作为 候补, 在厚的支架搁板上 :

1. Temporarily place the recorder in the correct position. Mark the location of the recorder's mounting hole on the shelf. 临时放置记录器于适当的位置。在搁板上标注记录器安装固定孔的位置。
2. Drill a hole with a 1/4" (6.4mm) drill through the shelf at this location.
用 1/4"(6.4mm)钻孔机钻一个孔洞穿透搁板的这个位置。
3. Insert a single 1/4-20 bolt through the hole from the bottom and into the recorder's mounting hole. 再从搁板底部向上穿透此孔洞插进一根 1/4-20 单纯的螺杆, 并进入记录器的暗转固定孔内。
4. Install the sealing washer, flat washer and nut as described in the *Floor Mounting* section. Tighten the nut to firmly hold the recorder in place.
如同在底板固定一节里所记述的那样, 安装密封垫圈、平面垫圈及螺母。拧紧螺母以使记录器稳固地保持在适当的位置。

WALL-MOUNTING 墙壁固定

If mounting the recorder on a wall is your only option, and your K2 **does not contain** an internal EpiSensor, you can do the following:

若你只能选择将记录器安装在墙上并且你的 K2 仪器不包含内置 EpiSensor 的话,那你可按下述去做 :

1. Use a bracket sturdy enough to hold the recorder. The bracket must have bolt holes that line up with the three 1/4"-32 holes in the recorder's baseplate (the leveling feet holes).

用一个足够坚固的托架将记录器托住。该托架的搁板上必须有螺栓孔洞，孔洞要与记录器底板上的三个 1/4-32 孔洞(找平脚孔)相配合。

2. Screw the nuts and bolts firmly together through the bracket and the recorder's base. 用螺栓和螺母结合使其穿透托架搁板与记录器底板稳固地集合在一起。

Alternately, use a single 1/4-20 bolt to secure the recorder.

作为候补，用一根 1/4-20 单纯的罗杆以保护记录器。

Grounding the Recorder 记录器接地

All users should complete this procedure. You must provide the recorder with a good, low-impedance earth ground before operating it for the following reasons:

所有用户应完成这个程序。 基于如下理由，在运行记录器之前你必须使其有良好的低电阻接地条件：

- To maintain the recorder as a highly sensitive, low-noise, seismic recorder. 为维持记录器作为一个高灵敏、低噪声的地震记录器。
- To shunt ESD transients, lightning-induced transients and EMI/RFI transients to ground. 为避免对地的 ESD 瞬变、闪电感应瞬变及 EMI/RFI 瞬变。
- To meet the requirements of the European Community's EMI/RFI directives. 为满足欧洲共同市场关于 EMI/RFI 指示的规定。

CE

Determine what earth ground you will connect the recorder to. A good earth ground includes the following: 确定你将连接记录器的接地是什么样的。一个好的接地条件应包含如下：

- a metal **plumbing** pipe that is eventually buried in the ground 一根最终埋入地下的金属管件；
- a copper ground rod staked in soil 一根用桩篱围在土中的接地铜棒；
- a well engineered electrical grounding system, or 一个良好的电工专业接地系统；或
- steel reinforcing rods that protrude from a concrete foundation. 从混凝土基础里出露的钢筋棒。

Prepare the conductor you plan to use to connect the recorder to the earth ground. For the conductor, you should at least use a heavy-gauge wire or, better yet, a copper strap or copper braid. 准备你打算用着连接记录器到接地点的导体。至于导体，你至少应该使用大规格导线，或更好的如铜条或铜编织带。

Connect this conductor to the recorder's case grounding stud near the bottom center of the recorder's front panel. Then connect the other end of the conductor/grounding strap to the selected earth ground. If the recorder has sensor connectors mounted on its cover, you must also connect the rear case-grounding stud to the ground connection.

将导体连接到记录器靠近前面板下边中间的记录器外盒接地线柱上。然后将导体/接地条带的另一端连接到选定的接地点处。如果记录器有传感器连接器装在它的盖上，你则还必须将仪器盒背面的接地线柱与地面接地点处连接。

Note: If the recorder is powered by the optional PSA, the third pin (earth connection) of the PSA AC plug provides the safety ground. To ensure the unit's low noise performance, you must still connect the recorder's grounding stud to a good earth ground as described above.

注释：如果记录器是用所选择的 PSA 供电，PSA 的交流插销的第三插脚(接地插脚)提供了安全接地。为了保证仪器的低噪声性能，你仍必须将记录器的接地线柱连接到上面所述的良好接地点。

THE MAKALU

Common Mode Voltage & EpiSensor Grounding**公共模式电压和 EpiSensor 接地**

The analog front end and analog-to-digital converter sections in the Makalu are 100% isolated from the DSP and MCU sections by optical isolators, capacitive isolators, and DC-DC converters. This also includes EpiSensor power.

在 Makalu 仪器里模拟前端和模数转换器部分与 DSP 和 MCU 部分是用光学隔离器、电容隔离器及 DC-DC 转换器所 100% 隔离的。这也包含 EpiSensor 动力。

There is a 5.5V transient suppression device on the input board. This means that the common-mode voltage between the sensor ground and Makalu power ground must still be kept to near zero. This isolation allows the EpiSensor and Makalu to share a common ground *at only one point*.

在输入板上有一个 5.5V 瞬变抑制装置。这表示传感器地线与 Makalu 动力地线之间的公共模式电压仍然必须保持接近于零。这种隔离办法允许 EpiSensor 和 Makalu 仅在一点上共享一个公共接地。

If an EpiSensor is connected to the Makalu with a short cable (a few meters in length), the EpiSensor can be allowed to float. Longer cables may require special consideration in deciding whether to tie the sensor ground to the Makalu power ground or to let it remain floating.

如果 EpiSensor 是用一根短电缆(约几米长)连接到 Makalu 的话，可以允许 EpiSensor 浮置。较长的电缆，可能需要专门考虑以决定是否将传感器地线接到 Makalu 动力地线或让它保留浮置。



WARNING! Potential electric shock hazard. The grounding stud is not a protective earth ground. If you connect the recorder to the mains supply, make sure that the protective earth ground is provided by the PSA as described in the *Connecting the Power Supply* section.

警告！潜在电冲击危险。 仪器接地线柱不是接地保护。如果你将记录器连接到主供电源，应确证接地保护如在 *连接供电电源* 一节所述是由 PSA 提供的。

Connecting Your PC 连接 PC 机

Use an optional RS-232 cable (P/N 109475) to connect your computer to the recorder. This cable is supplied as an accessory.

用一根所选的 RS-232 电缆(P/N 109475)将你的计算机连接到记录器。该电缆是作为附件提供的。

This section discusses how to complete the initial connection between your computer and the recorder. Refer to the *Verifying Basic Unit Operation* section for how to verify proper operation of the connection. Refer to the *QuickTalk &*

QuickLook Software User's Guide for further information about the QuickTalk software.

本节讨论如何完成你的计算机与记录器之间的初始连接。关于如何检验连接的正确操作请参考 *检验基本单元操作* 一节。关于 QuickTalk 软件的更进一步信息请参考 *QuickTalk 和 QuickLook 软件使用指南*。

The RS-232 cable has a 25-pin D-connector that plugs into your computer. If you have a laptop with a 9-pin connector, use the connector changer to convert the 25-pin to 9 pins. Then plug the 10-pin military style connector on the other end of the cable into the recorder port marked RS-232C.

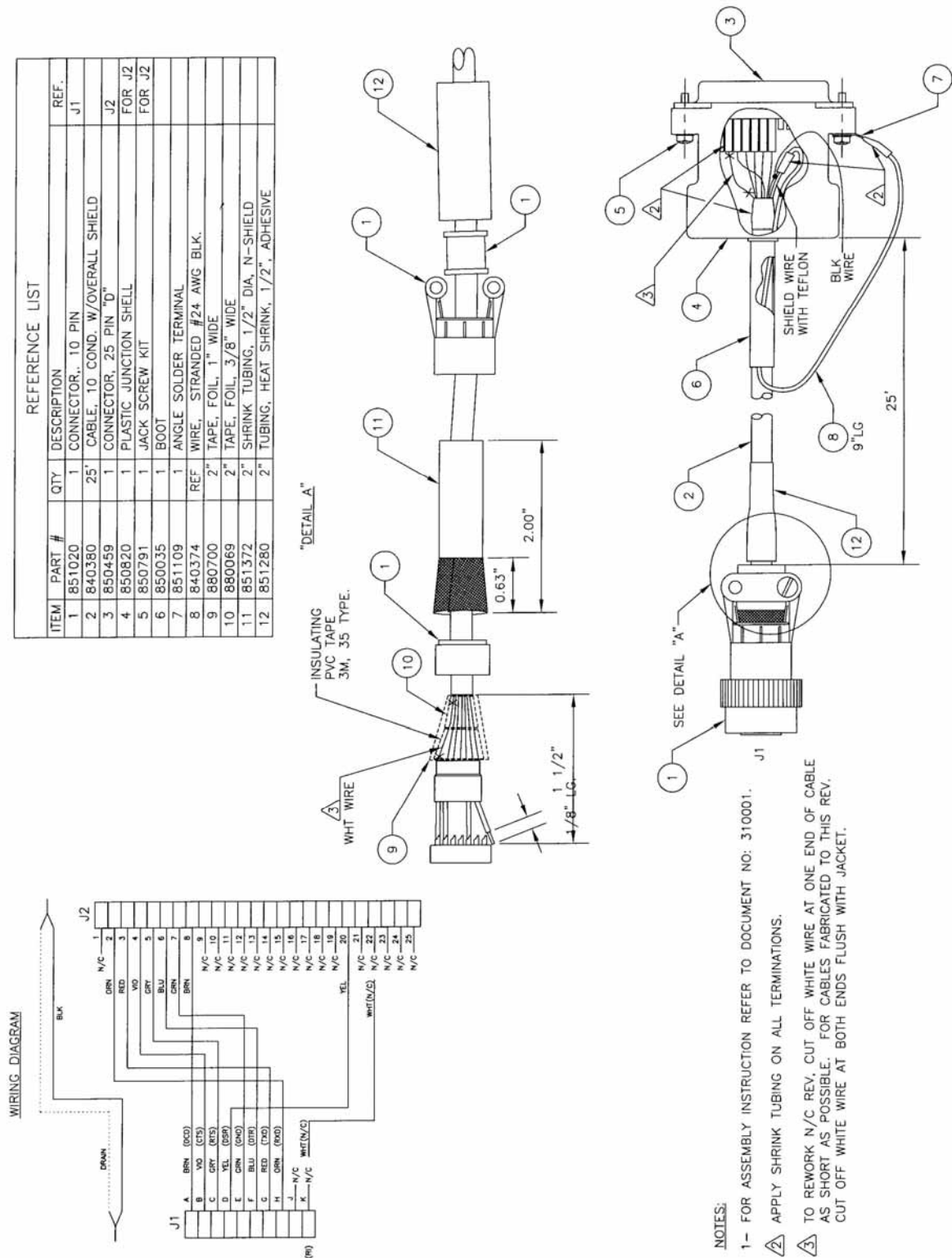
RS-232 电缆有一个 25-针脚 D-型连接器可插到你的计算机。如果你有一台带有 9-针脚插接口的膝上电脑，可用将 25-针脚转换为 9-针脚的转换接头。然后将电缆另外一端上的 10-针脚军用型连接器插进记录器标注为 RS-232 的插口。

To build your own RS-232 cable, refer to the next figure.

为制作你自己的 RS-232 电缆，请参考下图。

图 9 RS-232 电缆装配

Figure 9: RS-232 cable assembly



Connecting the Internal Battery 连接内置电池

A standard recorder includes one internal battery (a 13.6V, 12 Ah battery, KMI P/N 840503) already inside the case. Kinometrics ships this battery with the positive lead disconnected. When the internal battery is connected, it maintains power to the recorder for approximately 30 hours if AC power is lost. (The actual time depends on which options are installed.)

一台标准的记录器包含一块已经装在仪器盒中的内置电池(一块 13.6V、12Ah 电池, KMI P/N 840503)。Kinometrics 公司运输仪器时把电池正极断开。接上内置电池,在交流电源失效时可维持记录器用电约 30 小时(实际时间取决于所选用的电池容量)。

Connect the internal battery as follows: 连接内置电池如下:

1. Make sure the recorder's *OPER/STBY* switch is in the *STBY* position.
确证记录器的 *OPER/STBY* 开关是在 *STBY* 位置。
2. If the power supply assembly (PSA) is connected to the *EXT POWER* connector on the recorder's front panel, disconnect it now. Make sure the internal battery is still in the proper position, as shown in Figure 10, and that the black lead is connected to the negative (-) terminal on the battery's lower right side.

如果供电装置(PSA)是连接在记录器前面板上的 *EXT POWER* 接口上的话,现在请断开它。确证内置电池仍然处在如图 10 所示的正常位置,并且黑色接片是连接着电池右下边的负极上(见图 10)。

Caution: Potential equipment damage. All batteries and the PSA should be disconnected before you service the equipment because power is supplied to some of the circuit boards even when the *OPER/STBY* switch is in the *STBY* position. Reversed polarity battery connections can lead to instrument damage.

告诫: 潜在设备损坏。在你保养设备之前务须断开所有电池和 PSA, 因为即使当 *OPER/STBY* 开关置于 *STBY* 位置时某些电路板还供着电。电池的反极性连接会导致仪器损坏。

Figure 10: Internal battery**图 10 内置电池**

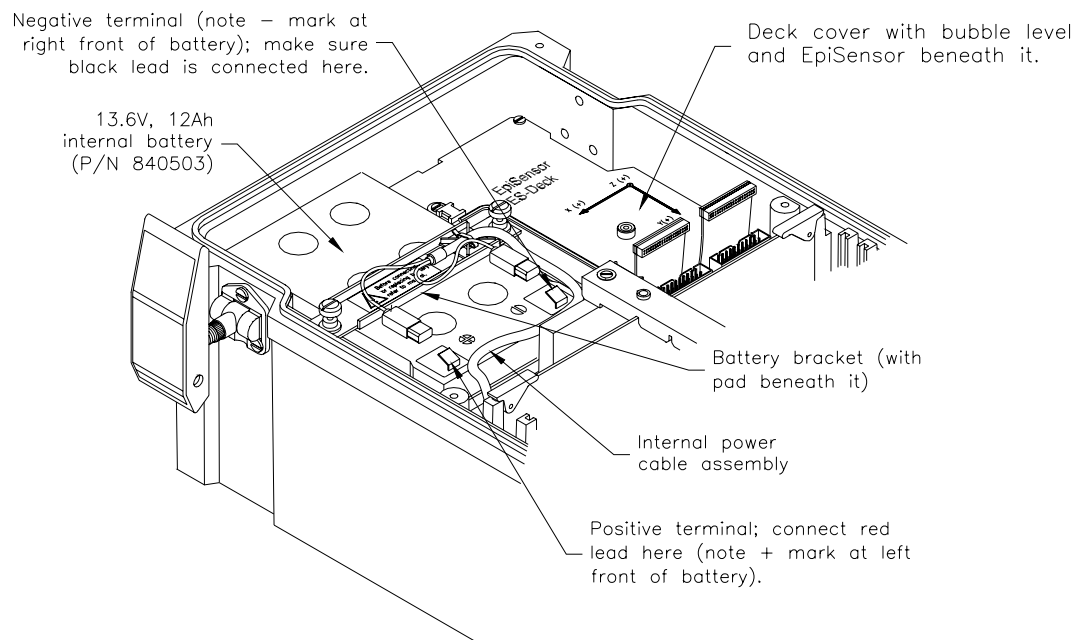
3. Connect the red lead to the positive terminal. The recorder's internal battery is now connected. 连接红色接片到正极。现在连接上了记录器的内置电池。
4. Use a DVM to measure the voltage across the battery terminals. The voltage reading for a new or freshly charged battery should be greater than 12 volts DC. 用数字电压表(DVM)跨电池两极测量电压值。对于新的或刚充好的电池，其电压读数应大于 12V DC。

If the reading is less than 12 volts, the internal battery has been significantly discharged. Connecting the unit with the internal battery installed to the PSA will completely recharge the internal battery overnight.

如果读数低于 12V，此内置电池已经明显地被放电。应将该仪器用 PSA 整夜再充电直到充满。



WARNING! Burn or fire hazard. Do not short the battery terminals with metallic conductors, such as a screwdriver or pliers. The battery can provide up to 80 amps of current. This amperage, when flowing through a non-isolated conductor, can result in very high temperatures and even fire.



Do not replace the supplied battery with a non-rechargeable battery or a battery that does not meet the requirements given in Chapter 4 in the *Replacing Batteries* section.

警告！燃烧或火灾。绝不用金属导体诸如螺丝起子或钳子短接电池两极。电池能够提供多到 80 安培电流。这样的安培数流过非绝缘导体时会产生非常高的温度甚至火灾。**绝不用非可充电电池或不满足第 4 章 更换电池**一节规定的电池去替换仪器电池。

Refer to the *Connecting the Power Supply* section for instructions on how to connect AC power. Refer to Chapter 6 for instructions on how to connect an optional external battery or a solar charging system.

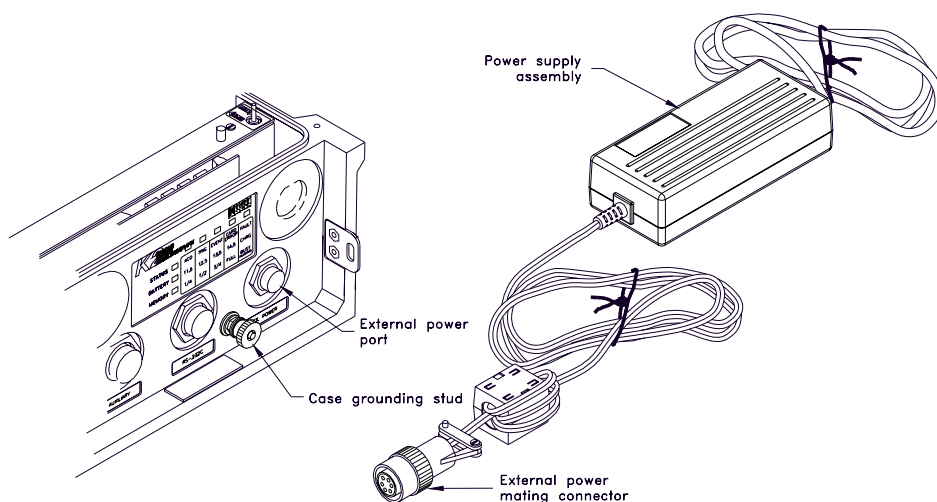
关于如何连接交流电源请参考**连接供电电源**一节。关于如何连接选用的外接电池或太阳能充电系统，则请参考第 6 章。

Connecting the Power Supply 连接供电电源

The recorder optionally includes a wide-input DC power supply assembly (PSA, P/N 109480 or 109485), which connects to a standard AC outlet, shown in the figure below. 记录器可任意选择地包括一个宽范围输入的 DC 供电装置(PSA,P/N 109480 或 109485)，它可连接到交流输出插座，如下图所示。

Figure 11: Power supply assembly (PSA)

图 11 供电装置(PSA)



Caution: Using the wrong power supply unit with the recorder can permanently damage its circuit boards. Do not attach any power supply assembly to the recorder other than the one supplied by Kinometrics unless it exactly matches the voltage and current ratings required for the recorder. Note that the K2 and Makalu use the same wide-input DC power supply (refer to *User-Supplied Charging Systems* in Chapter 6 for more information). Do not use an ETNA power supply unit with a K2 or try to power an ETNA with a K2 PSA, in both cases the units will be badly damaged.

告诫：使用错误的供电单元给记录器，会使仪器电路板永久损坏。除了 Kinometrics 公司所提供的请不要配属任何其它供电装置，除非该装置能与记录器需要的电压和电流额定值正确匹配。注意 K2 和 Makalu 使用同样的宽范围输入的 DC 供电电源(若需更多信息请参考第 6 章里用户提供的充电系统)。绝不要把 ETNA 的供电单元给 K2 使用，或试着把 K2 的 PSA 为 ETNA 供电，在这两种场合都会使仪器单元受到严重的损坏。

Before plugging in the PSA: 插进 PSA 之前：

- Make sure that the AC outlet is properly wired.

确证交流输出电源接线正确。

- Find out if the local AC power is subject to interruption, brownouts, or **spikes**. If it is, plug a suitable surge suppresser into the AC outlet. (*Strongly recommended!*)

如果发现有当地交流供电遭受断电、限电管制或电压突跳等供电不稳的状况，应在交流输出电源上插接一个电涌浪抑制器。(强烈建议！)

Then do the following: 然后按如下做：

1. Remove the cover of the recorder. Make sure the unit's OPER/STBY switch is in the STBY position. 打开记录器盖，确证仪器的 OPER/STBY 开关处于 STBY 位置。
2. Push the 6-pin external power connector onto the recorder's EXT POWER connector and twist until it locks. 将 6-针脚外接供电接头插到记录器的 EXT POWER 插座上，并拧到它锁住。
3. Plug the PSA into the AC power outlet or surge suppressor. (Users outside the U.S. must use an adapter or an appropriate IEC line cord with the correct AC plug.) 将 PSA 插进交流供电电源或电涌浪抑制器。(在美国之外的用户必须用一个适配器或一个合适的带有正确的 AC 插头的 IEC 电源软线。)

Note: The PSA automatically adjusts for line voltages from 90 to 260 VAC (either 50 or 60Hz) without user intervention. The electrical characteristics of the recorder's external power connector are described in the *Detailed Electrical Interface* section in Chapter 5.

注释： PSA 对于线压在 90 到 260 V AC (或者 50 或 60Hz)的交流电可以自动调节而无需用户干预。关于外接电源连接器的电特性可参见第 5 章 *电气接口详述* 节里的记述。

Verifying Basic Unit Operation 检验基本单元操作

TURNING ON THE POWER 接通电源

1. Make sure the PCMCIA memory card is inserted into slot A. (The PCMCIA slot is located on the right-hand side when you face the front of the unit. Its location is also **silk-screened** on the recorder's PCMCIA board.) 确证 PCMCIA 记忆卡是插在槽口 A 内。(当你面对仪器前面板时 PCMCIA 槽口是处在右手边上的。它的位置在记录器的 PCMCIA 板上也是**用丝织遮挡着的**。)
2. Turn the *OPER/STBY* switch to the **OPER** position. 拨动 OPER/STBY 开关至 **OPER** 位置。

The lights on the recorder's front panel will light up briefly, and then light up in a pattern that indicates the baud rate. Refer to the *Running QuickTalk for the First Time* section of the *QuickTalk & QuickLook User's Guide* at the back of this binder to interpret the recorder baud rate setting from the LED display.

这时记录器前面板上的指示灯将短暂闪亮，并随后以显示波特率模式点亮。为从发光二极管显示解释记录器波特率请参考附在本文件夹后面的 *QuickTalk 和 QuickLook 使用指南* 中的 *初次运行 QuickTalk* 一节。

After the baud rate displays, the LEDs will not light up for several seconds. Then the LEDs will light up in the moving pattern described below in the *Front Panel Display* section.

在波特率显示之后，发光二极管将熄灭几秒钟。然后发光二极管将以在下面的 *前面板显示* 一节里记述的移动模式点亮

FRONT PANEL DISPLAY 前面板显示

The recorder uses super bright LEDs to show the unit's status. It automatically cycles the LEDs to provide a simple matrix display, as illustrated in Figures 11-13. During a cycle, the appropriate LEDs in each row turn on for three seconds before the cycle moves to the next row. 记录器用超亮发光二极管显示仪器状态。仪器能自动地循环发光二极管提供着一个简单矩阵显示，如图 12-14 所示。在一个循环期间，每排里适当的发光二极管会开启 3 秒钟，在轮番移动到下一排。

The left column is the row indicator. When the *STATUS* LED is lit, the LEDs across the top indicate the recorder's status as shown in Figure 12. They are abbreviated as *ACQ*, *TRIG*, *EVENT*, *CARD ERROR*, and *FAULT*.

图 12-14 中左列是排指示器。当状态发光二极管点亮，横过顶部的发光二极管指示记录器的状态如图 2 所示。它们简化为 *ACQ* 获取、*TRIG* 触发、*EVENT* 事件、*CARD ERROR* 卡错，以及 *FAULT* 故障。

Figure 12: Status display

图 12 状态显示

		■	□	■	□	□
STATUS	■	ACQ	TRIG	EVENT	CARD ERROR	FAULT
BATTERY	□	11.5	12.5	13.5	14.5	CHRG
MEMORY	□	1/4	1/2	3/4	FULL	BUSY (FLASHING)

The display indicates that the recorder is in acquisition mode (the normal operating mode), and that recorded events are stored on disk. 现在此图显示记录器处于获取模式(正常操作模式)，并且记录的事件存储到磁盘上。

Figure 13: Battery display

图 13 电池显示

		□	□	■	□	■
STATUS	□	ACQ	TRIG	EVENT	CARD ERROR	FAULT
BATTERY	■	11.5	12.5	13.5	14.5	CHRG
MEMORY	□	1/4	1/2	3/4	FULL	BUSY (FLASHING)

In Figure 13 the display reports the status of the unit's internal battery. Note that the *BATTERY* LED is lit. This indicates that the battery is at approximately 13.5V and that the charger is connected and providing DC power. The battery voltages are rounded off to the nearest 0.5V: 11.5 = 11.0 to 12.0, 12.5 = 12.0 to 13.0, 13.5 = 13.0 to 14.0, and 14.5 = > 14.0V. 在图 13 里，显示报告了仪器内置电池的状态。注意这时 电池发光二极管是点亮的。它指示电池大约为 13.5V，并且充电器被连接着，正在供给直流电。电池电压以最接近的 0.5V 进行舍入：11.5=11.0—12.0、12.5=12.0—13.0、13.5=13.0—14.0、以及 14.5=> 14.0。

Figure 14: Memory display

		■	□	□	□	□
STATUS	□	ACQ	TRIG	EVENT	CARD ERROR	FAULT
BATTERY	□	11.5	12.5	13.5	14.5	CHRG
MEMORY	■	1/4	1/2	3/4	FULL	BUSY (FLASHING)

图 14 记忆显示

In Figure 14 the display reports the amount of memory used in the PCMCIA card. Note that the *MEMORY* LED is lit. This example shows that the unit's memory is one-quarter full or less. (Memory use is rounded up.) 在图 14 里，显示报告了 PCMCIA 卡中已用的内存总数。注意这时内存发光二极管是点亮的。此例显示仪器内存已装入四分之一容量或少于四分之一容量。（内存使用是以四舍五入计算的。）

Caution! Potential data corruption! When the last LED on the bottom right-hand side is flashing rapidly (approximately twice per second), the recorder is accessing the PCMCIA memory card. Do not remove a PCMCIA card from the unit while this light is flashing.

告诫！潜在数据丢失！当底部右边最后的发光二极管正在快速闪亮（约每秒两次）时，表明记录器正在访问 PCMCIA 内存卡。在该发光二极管正在闪亮时请不要将 PCMCIA 卡从仪器中拆除。

Running QuickTalk 运行 QuickTalk

Start your PC and double-click on the QuickTalk icon on your PC screen. Follow the instructions in the *Running QuickTalk for the First Time* section in the *QuickTalk & QuickLook Software User's Guide* at the back of this binder.

启动你的 PC 机并双击你的 PC 机屏幕上的 QuickTalk 图标。请跟着附在本文件夹后面的 *QuickTalk 和 QuickLook 软件使用指南* 中的 *初次运行 QuickTalk* 一节的指示去做。

Note: You can also connect to the recorder with most communication programs, such as HyperTerminal® or CrossTalk®.

注释：你也可以用许多通信程序诸如 HyperTerminal® 或 CrossTalk®，连接记录器。

Zero-Adjusting Internal EpiSensors

内置 EpiSensor 摆调零位

If the K2 has an internal EpiSensor deck, most users "zero" the EpiSensor accelerometers after the recorder is installed and leveled. Zeroing the EpiSensor deck channels ensures that recorded data will have minimal DC offset. You can zero the accelerometers by using the recorder's DVM utility to monitor the offsets as you manually adjust them.

如果 K2 有内置 EpiSensor 装置，大多数用户在记录器安装及找平之后要对 EpiSensor 加速度计“调零位”。对 EpiSensor 装置各通道进行调零位可保证记录器数据将有最小的 DC 偏移。你在用手调节各加速度计零位时可用记录器的 DVM 指令监测偏移量值。

Caution: If you have an Altus-series recorder, its firmware will allow you to remove an offset from the data stream by subtracting a constant value from the data as it is recorded. However, you should only use this to remove a small residual offset. If you remove a large offset, (>100 mV) you will reduce the instrument's recording range.

告诫：若你有一台 Altus 系列记录器，其固件将允许你用被记录的数据中减去一个常数量值的办法从该数据流里除去一个偏移量值。然而，你应该只是用此办法除去小的残留偏移量值。如果你用此办法除去一个较大的偏移量值 (> 100mV)，那将会减少仪器的记录量程。

The modules can be adjusted to an offset of less than 25mV or less than 5 milli-g for high sensitivity units. (If desires smaller offsets may be obtained with some practice.) For normal applications in which the K2 is level, the adjustment screw rotation will be only a few degrees. The modules are zeroed before shipment. The table below shows suggested offset settings for the gain and full scale ranges available in the internal EpiSensor deck: 可以调节加速度计模块以使偏移值低于 25mV 或对于高灵敏仪器则低于 5 m-g(毫重力加速度)。(若希望取得小偏移值，只有多加练习。)对于 K2 被找平的常规使用，调节旋杆只是旋转几度。该模块在装运之前已被调好零位。下表显示了对可用于内置 EpiSensor 装置的增益和满量程所建议的偏移值设置。

Table 1: Suggested offset limits

表 1 建议的偏移量值限制

Full-scale range	Single-ended ± 2.5 V output	Single-ended ± 10 V output
1/4g	50 mV	200 mV
1/2g	25 mV	100 mV
1g	25 mV	50 mV
2g	25 mV	25 mV
4g	25 mV	25 mV

Adjustment Instructions 调节指示

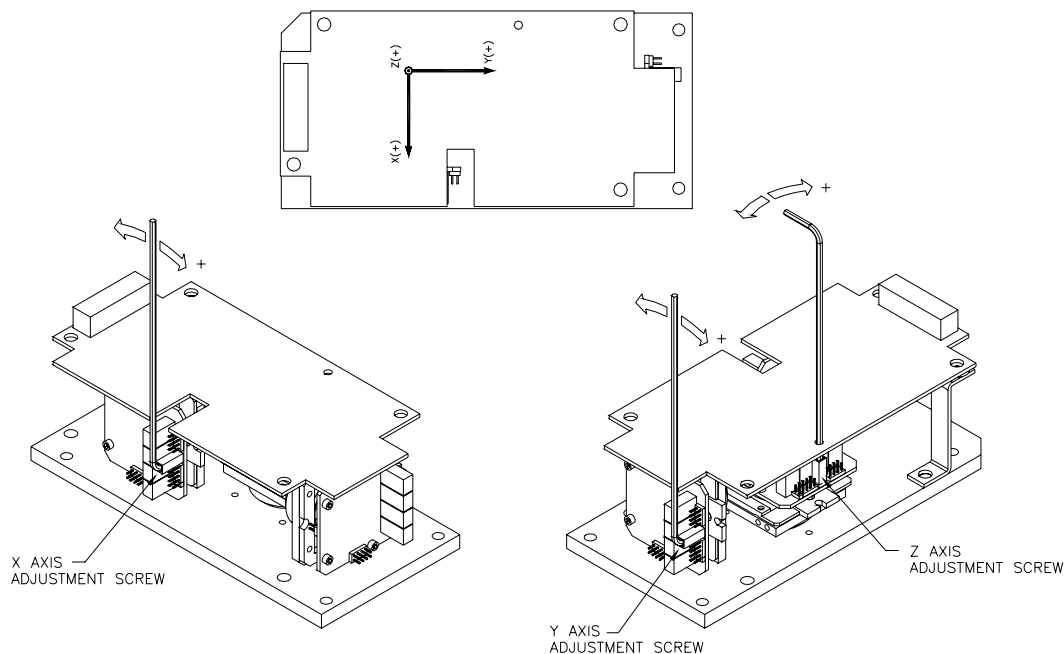
1. Turn the *OPER/STBY* switch to **OPER**. Start QuickTalk and open the Terminal window. 拨动 *OPER/STBY* 开关至 **OPER** 位置。启动 QuickTalk 并打开终端窗口。
2. Enter **AQ DVM** to display the current voltages of the EpiSensor in millivolts. The DVM display screen appears. Look in the column that corresponds to the sensor channel you are adjusting. As you complete the adjustment procedures below, watch the figures in this column to see when the voltages are in the proper range. 进入 **AQ DVM** 以显示 EpiSensor 的当前电压以毫伏 mV 计。此时 DVM 显示屏幕呈现。访问相应于你正在调节的传感器通道一栏。当你完成下面的调节程序同时，注视进入该栏的数字，以看何时电压值进到正确值范围。
3. Check the above table. If the voltage exceeds the limits for the full- scale range, remove the sensor cover and use the tool provided on the cover to adjust the channels. (Remember the AQ DVM display is in millivolts not volts.) 检查上面的表。如果电压值超出满量程限制，请打开传感器盖并用该盖上所提供的工具调节该通道。（应记住 AQ DVM 的显示是毫伏而不是伏。）
4. The following drawing shows where to insert the adjustment tool for each EpiSensor channel. As the figure indicates, EpiSensor modules produce a positive output when the adjustment screw is turned clockwise. Monitor this with the DVM utility. 下图出示了对每一个 EpiSensor 通道应在何处插入调节工具。如图所示，当调节旋杆以顺时针方向转时 EpiSensor 模块产生一个负输出。用 DVM 指令可监测它。

Note: If you have mapped the EpiSensor into the negative-polarity L, V, T coordinate system, clockwise rotation of the adjustment screw will produce a negative output when monitored by the DVM utility.

注释： 若你绘制 EpiSensor 进入负极 L、V、T 坐标体系，顺时针旋转调节旋杆将可产生一个负输出，这时可用 DVM 指令监测。

Figure 15: Zero-adjusting an internal EpiSensor deck

图 15 内置 EpiSensor 装置的零位调节



5. When the channel is adequately adjusted, gently remove the tool.
当该通道经仔细地调节好后，请轻轻地移出工具。
6. After adjusting all the channels, replace the deck cover.
在调节完所有通道后，将该装置盖复原。
7. **Important:** Give the cover a moderate tap with a screwdriver handle after replacing the cover. The adjustment screw can have a residual stress that may cause an offset in data during a large earthquake. Tapping it will eliminate the residual stress.
重要的：在将盖复原后用螺丝起子把手对盖子适度轻叩。由于调节旋杆可能有残余应力，当大地震时可能会对数据产生偏移。轻叩盖子将会消除残余应力。
8. Check that the sensors are still in the acceptable range.
再检查传感器零位电压，应仍然处于可接受的范围。

Maximizing EpiSensor Performance EpiSensor 摆性能最佳化

Do not use a PCMCIA hard disk on a K2 with an internal EpiSensor deck or with an Makalu recorder. The disk drive vibrations will be recorded and greatly increase the noise level of the sensor. 在带有内置 EpiSensor 装置的 K2 仪器

上或用 Makalu 记录器时，不要用 PCMCIA 硬盘。因为磁盘驱动的振动将会被记录并极大增加传感器的噪声水平。

In general, it is unwise to use a gain board with an instrument that has an internal EpiSensor deck because the sensor is more susceptible to several types of noise. Increasing the gain of the unit will therefore not achieve the intended result of lowering the noise floor; instead, it will reduce the dynamic range by raising the noise above the digitization threshold. To achieve the best noise performance, use external EpiSensors.

一般而言，对于带有内置 EpiSensor 装置的仪器用增益板是不明智的，因为传感器对几种类型噪声更为敏感。仪器的增益逐渐增加将因此不能达到降低噪声地板想要的结果

When using a recorder with multiple external EpiSensors, be certain that the *dynamic* power requirements of the sensors do not exceed the capacity of the recorder. When EpiSensors are configured to use their low noise amplifiers, they use significantly more power than FBA-23s.

当使用一台带有多个外接 EpiSensor 的记录器时，无疑地，传感器的动态功率需要不能超出记录器的容量。当 EpiSensor 配置为使用其低噪声放大器时，他们使用功率明显地大于 FBA-23。

Be sure to gauge how much power you will need based on the *dynamic* power requirements of your instruments rather than on the static requirements. If inadequately powered during a large event, EpiSensors may not be able to accurately record large acceleration peaks.

肯定地，为测量多大功率，你将只能需要基于动态功率需要之上而不能基于静态需要之上的。如果当大事件时供电不当，EpiSensor 可能不会正确记录较大的加速度峰值。



WARNING: Antenna and Phone Installation: Never install antenna or telephone wiring during electrical storms. Always ensure adequate separation between antenna cabling or telecom cabling and high voltage wiring. Always perform a safety check on telecom wiring to measure the voltage before working on the wiring. Remember telephone wiring carries fifty (50) to sixty (60) volts of DC and the ring signal at ninety (90) VAC can deliver a very uncomfortable shock.

警告：天线和电话安装：当闪电风暴时绝不可安装天线或电话线。始终保证天线电缆或电信电缆与高压线之间有足够的分离。总是履行对电信线路的安全检查以在线工作之前测量该电信线路电压。记住电话线带有 50 伏到 60 伏直流电压，并且在 90 伏交流电压的铃音信号能释放出不舒服的电冲击。

Connecting the Internal Modem 连接内置 Modem

If you purchased a recorder with an internal PCMCIA modem, then the modem is already installed and wired into alternate slot B on the back of the PCMCIA

card. To use this modem, you must install a suitable telephone jack at the recorder site. Once that is done, do the following:

如果你买一个带有内置 PCMCIA 调制解调器 modem 的记录器，该 modem 是已经安装和接线于 PCMCIA 卡背面上的替换槽口 B 内的。为了使用该 modem，你必须在记录器场所安装一个适配的电话接口。一旦这些都做了，即可继续做如下：

Caution: Do not install any other PCMCIA cards into slot B when there is a modem in alternate slot B.

告诫：在替换槽口 B 内插有 modem 时，请不要再装任何另外的 PCMCIA 卡于槽口 B 中。

1. Plug the military-style connector on the telephone cable supplied into the mating connector located on the right side of the recorder, beneath the right-front cover latch. (The cable has a standard RJ-11 telephone connector on one end and a military-style 4-pin connector on the other.) 将所提供的电话电缆上的军用型连接器插进处于记录器右边在右前盖吊扣之下的匹配连接器。（在该电缆一端有一个 RJ-11 标准电话接头，而另一端则是一个军用型 4-针脚插头连接器。）
2. Plug the RJ-11 jack at the other end of the cable into the phone-jack plug. The connection is complete. 将电缆另一端的 RJ-11 接头插进电话接口。
3. To protect the line against lightning-induced transients, install an optional telephone line surge-suppressor between the telephone plug and the jack. A suitable surge-suppressor is available from Kinometrics (P/N 851293). 为了保护线路抵抗闪电感应瞬变，在电话插头与接口之间安装一个选用的电话线路浪涌抑制器。配套的电话线路浪涌抑制器可由 Kinometrics (P/N 851293) 购得。

Caution: Potential equipment damage. The surge suppressor must be connected to an earth ground to function properly.

告诫：潜在设备损坏。该浪涌抑制器必须与功能保护接地相连。

Connecting a GPS Timing System 连接 GPS 时钟

Power down the recorder and disconnect the internal battery and the power supply assembly before installing a GPS antenna. Refer to the *GPS Timing Systems User's Guide* in the back of this binder for instructions.

在安装 GPS 天线之前先关闭记录器电源和切断内电池与供电装置。请参考在本指引文件夹后面的 *GPS 时间系统使用指南*。

Caution: Potential equipment damage. The recorder must be powered down and the internal battery and power supply assembly must be disconnected before connecting a GPS antenna.

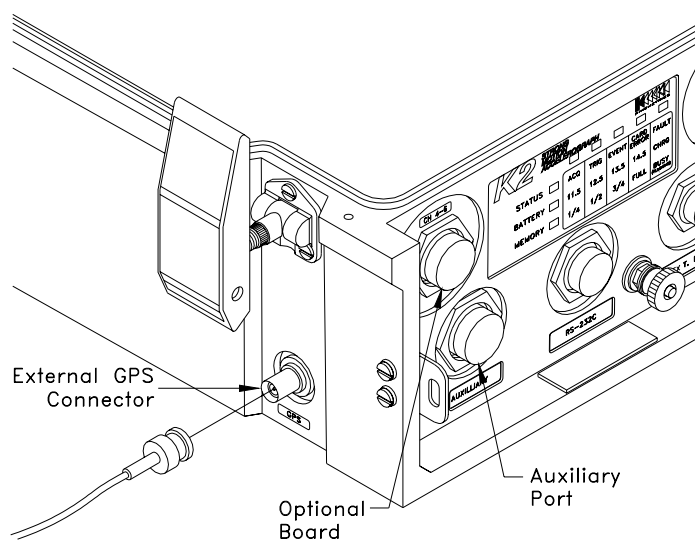
告诫：潜在设备损坏。在连接 GPS 天线之前，务须将记录器电源关闭，并使内置电池与供电装置断开。

Once the antenna is installed, connect the GPS cable's BNC male connector to the unit's GPS (RF) connector (on the left side of the recorder's enclosure). Both parts are visible in Figure 16.

一旦天线安装好，请将 GPS 电缆的 BNC 插头连接到该仪器的 GPS(RF)连接器上（在记录器外壳的左边）。此两部件都显示在图 16 上。

Figure 16: Connecting a GPS cable

图 16 GPS 电缆连接



Setting Up Optional Gain Boards 安装增益板选件

Refer to the installation instructions in the *Gain Board Operating Manual* (Doc. 302206) for instructions on using gain boards with your recorder.

关于将增益板用于你的记录器的指示请参见 *增益板运行手册* (Doc.302206) 中的安装指引。

Connecting External Modems 连接外设 Modems

Connect an external modem to the RS-232 connector on the recorder to communicate with the recorder remotely. Install the modem according to the manufacturer's instructions. 将一个外接 modem 与记录器的 RS-232 接口相连接，以供远程记录器的通信。请按照制造者的指示安装 modem。

The recorder site must include a power supply for the external modem. In order to maintain remote modem communication in case of a mains power supply failure, you must provide the modem with a back-up power system. 在记录器场所必须包含一个外接 modem 的供电源。为了在主电源失效的情况下维持远程 modem 通信，你必须为 modem 提供后备电源。

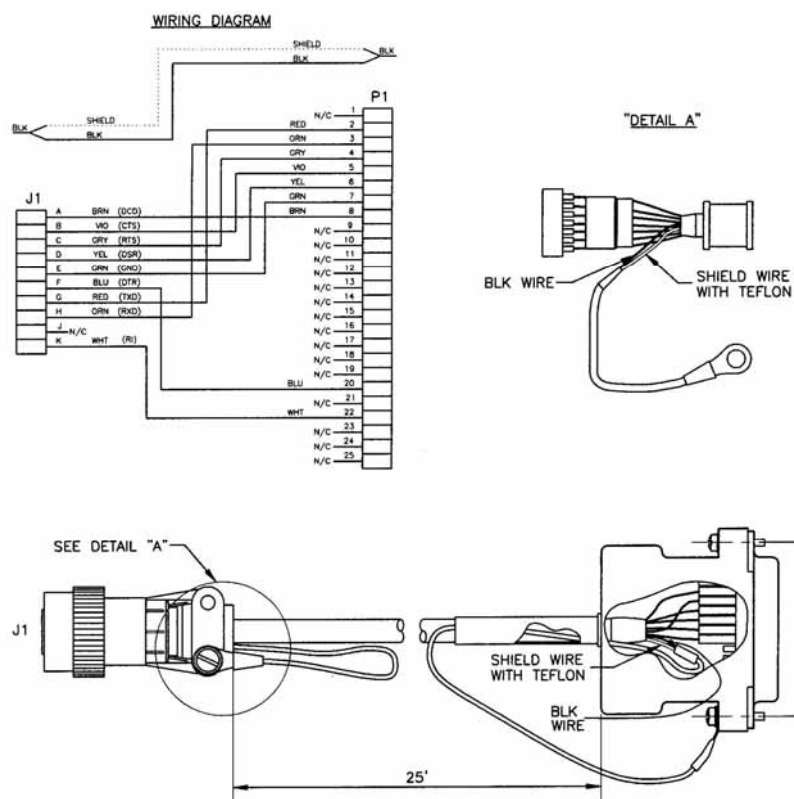
Preparing a Modem Cable 准备 Modem 连接电缆

Prepare the modem cable according to the schematic in Figure 17 or purchase a modem cable from Kinometrics. 请按照图 17 示意准备 modem 电缆或从 Kinometrics 公司购买 modem 电缆。

Make sure the recorder and modem are both un-powered before plugging the modem cable into the recorder. Then plug the military-style end of the modem cable into the RS-232 port and connect the DB-25 connector on the other end of the cable into the modem. 确证在将 modem 电缆插进记录器之前记录器和 modem 双方都切断了电源。然后将 modem 的军用型端头插进 RS-232 口，并连接电缆另一端的 DB-25 连接器到 modem。

Figure 17: Modem cable to connect to recorder unit

图 17 调制解调器电缆连接记录器单元



Connecting to a Telephone System 连接到电话系统

Plug one end of the telephone cable into the external modem jack labeled Line and the other end into the wall jack. As with the internal modem, we recommend installing a surge suppressor. A suitable surge suppressor is available from Kinemetrics (P/N 851293). 将电话电缆一端插进外接 modem 标记有 Line 的接口，并将另一端插进墙上电话接口。如用内置 modem，我们建议安装一个浪涌抑制器。Kinemetrics 公司可提供适配的浪涌抑制器 (P/N 851293)。

Verifying Modem Operation 检验 Modem 的运转

To verify the operation of your internal or external modem, you need to be sure that the recorder can both answer and place a phone call. 为检验你的内置或外接 modem 的运行，你必须肯定记录器能回答和打出一个电话。

- The recorder modem's initialization string (ATS0 = 1 for a Hayes-compatible modem) should be set to allow **Auto Answer**. (See the *QuickTalk/QuickLook* manual for more detailed information.) 记录器 mode 的设定初值字串(初始化字串)(对于 Hayes-兼容 modemATS0=1)应置于允许自动回答。(若需更多详细信息请参见 *QuickTalk/QuickLook* 手册)
- Using the **Terminal Window**, put the recorder into answer mode by typing **Answer** at the prompt. 使用终端窗口，在提示处键入 **Answer** 将记录器置成回答模式。

- Call the recorder using a PC with a modem. Verify that the recorder answers the call and that the PC at the other end can communicate with the system. 用带有 modem 的 PC 机呼叫记录器。检验记录器回答呼叫，并且 PC 机在另一端能与系统通信。
- To verify that the recorder can make a call, use the QuickTalk modem parameter screen to enable the **Auto Call** mode for loss of AC power. 为了检验记录器能做电话呼叫，使用 QuickTalkmodem 参数屏幕能置成**自动呼叫**模式；不过该自动呼叫模式会损耗交流电力的。
- Set the primary number for the recorder to call. 设置记录器要呼叫的首要号码。
- Download these parameters. 下载这些参数。
- Use **Terminal Window** and enable **Auto Call** mode. 使用终端窗口和置成自动呼叫模式。
- Disconnect the PSA from the recorder. The recorder should now initiate a call. 从记录器断开 PSA；现在记录器将会发出一个电话呼叫。

Powering Down 切断电源

To power down the recorder, read the following notes carefully and then move the *OPER/STBY* switch to **STBY**. 为了关闭记录器电源，请仔细地阅读下列注释，并且然后拨动 *OPER/STBY* 开关到 **STBY**。

Caution: Potential data loss. Do not disconnect the leads to the recorder's internal battery until the recorder is in STBY mode. This enables the system to close any open files and shut down in an orderly manner.

告诫：潜在数据丢失。在记录器处于 STBY 模式之前，绝不能断开记录器的电池线夹。这将使系统能关闭任何打开的文件和以有秩序的方式停止。

Note: When the internal battery voltage drops to < 10.6V, a normal battery discharge cycle alerts the recorder processor to close any open files and shut down the unit in an orderly fashion. When power is restored, the recorder will automatically turn on.

注释：当内置电池下降到 < 10.6V 时，一个正常的电池放电循环警告记录器处理器以关闭任何打开的文件和以有秩序的方式将仪器停止运行。而当电力恢复时记录器将自动打开。

Documenting the Installation 安装建档

Remember to document the following aspects of your installation:

将下列你的安装情况记入文档：

- The exact location of the unit 仪器的准确位置
- The orientation of each sensor 每个传感器的方向

We recommend that you take a photograph of the recorder along with each optional external sensor to record its orientation. In addition, prepare detailed instructions on how to access the recorder including maps, contact information, and clear directions for entering the structure that houses the unit. Experience has taught us that such records are extremely useful. In an emergency, untrained personnel might need to visit the site to retrieve data.

我们建议你对记录器连同每一个外接传感器拍一张照片，以记录它的方位。另外，请准备关于如何访问记录器的详细指引，包括地图、联系接触信息、以及进入该仪器柜室所在的房屋结构的清楚的指示。经验教育我们这样记录极为有用。因为在紧急情况下，从未到过此地的人员可能访问此场地回收数据。

3. Configuring & Operating Instruments 设置和操作仪器

Overview 总论

The recorder can be configured to gather data for both strong and weak motion applications; the purpose of your installation will determine the triggering and filter parameters that you set. 记录器可以设置成收集强震动和弱震动两方面使用的数据；你的安装目标将决定你要设置的触发和滤波器参数。

This chapter includes basic operating instructions and will frequently refer you to the *Using QuickTalk & QuickLook Software User's Guide* (Doc. 302208, in the back of this binder) for further specific instructions. 本章包含基本的操作指引，并且对于更进一步的详细指示将请你经常查阅 *QuickTalk & QuickLook 软件使用指南*(Doc. 302208,在本文件夹后面)。

Configuring Instruments 设置仪器

The K2 and Makalu are versatile instruments that can be used for a variety of tasks. In this chapter we explain the different ways to configure them in order to record the kind of data you want. More detail on the firmware operation is included in the *Reference* chapter. K2 和 Makalu 都是可供多种任务使用的通用型仪器。在本章里，我们将阐明设置它们的不同方法以记录你所要的数据种类。关于固件运行的更多细节包含在 *参考资料*一章里。

The K2 and Makalu are normally used as event triggered recorders. To operate them correctly, both what will be recorded and what will trigger the unit to record need to be set up. The settings that affect these functions can be divided into the following areas: K2 和 Makalu 通常是作为事件触发式记录器使用。为正确操作它们，必须明确提出什么是要记录的和什么是触发仪器进行记录的两。影响这些功能的设置可以分别进入如下区域：

- Station parameters — These determine which channels are recorded and information on the instrument. 台站参数——这些确定所记录的通道和关于仪器的信息。
- Stream parameters — These determine what sampling rate the instrument will record at, how the data will be filtered, and how long before the trigger and after the de-trigger the unit will record. 数据流参数——这些确定仪器记录时所使用的采样率、数据滤波的方法、以及使仪器触发前和触发以后将记录的数据流要多长。
- Channel trigger parameters — These select what type of seismic signal will cause an individual channel to be considered triggered. 通道触发参数——这些选择将导致一个单独通道作为考虑触发的地震信号的类型。
- Trigger voting parameters — These determine what combination of triggered channels and external inputs are required to cause the unit to trigger and record. 触发投票参数——这些确定为导致仪器触发记录的触发通道和外部输入的结合。

The following figure illustrates these areas so you can see how they relate to the flow of data through the instrument. 下图举例说明这些区域，你能看到它们是如何与通过仪器的数据流联系的。

Figure 18: Flow of data through Altus instruments

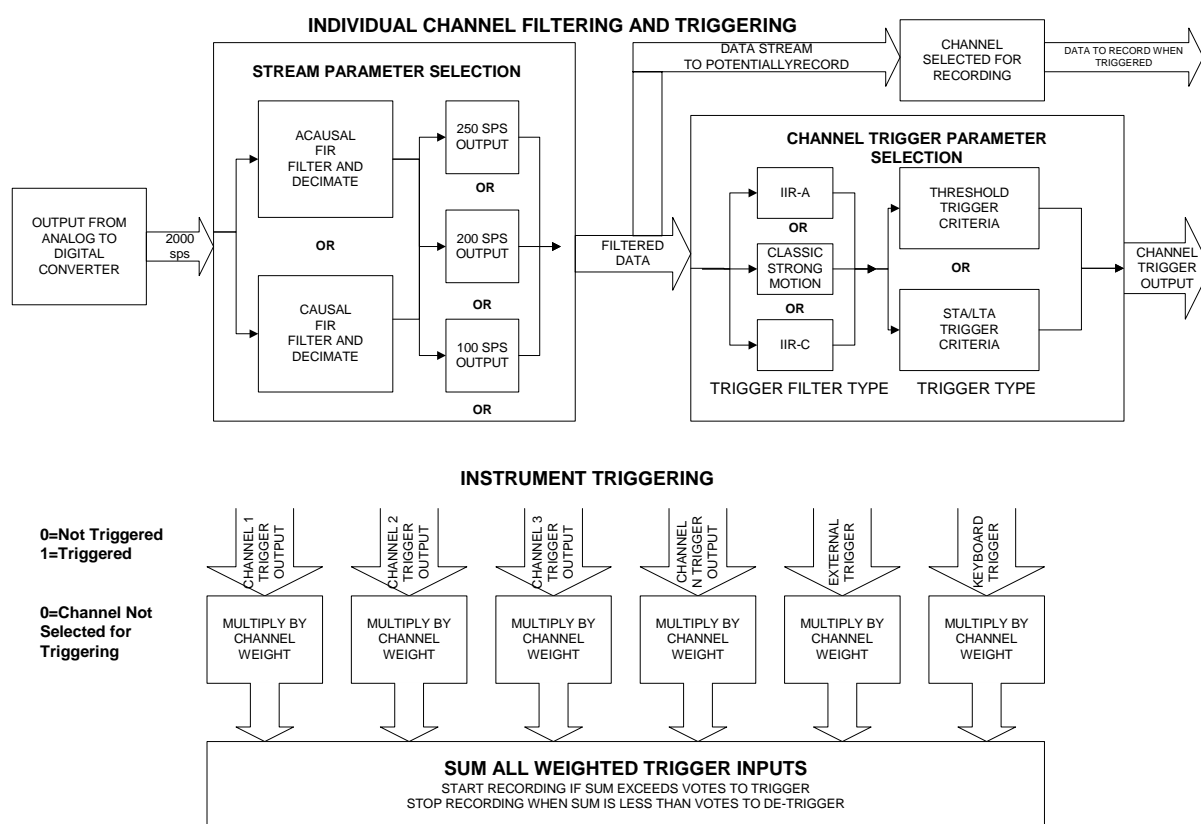


图 18 通过 Altus 仪器的数据流

Other instrument parameters have to be set to determine how the instrument handles: 其它的仪器参数必须设置以确定仪器如何操作：

- Data storage configuration – Where files are stored and the instrument's directory structure. 数据存储配置—文件存储地点和仪器目录结构。
- Communication options — These determine the modem settings, how power to a cellular phone is controlled, and when the recorder calls you. 通信选项—这些确定 modem 设置，如何控制便携电话供电，以及何时记录器呼叫你。
- Digital field station configuration — These determine whether or what data is sent on the auxiliary digital output port. 数字野外台站配置—这些确定在辅助数字输出口的数据是否送出。
- Serial data stream configuration— These determine if real time packetized data is sent out on the RS232 port. 串行数据流配置—这些确定在 RS-232 口实时打包数据是否送出。

- Sensor settings — These allow you to change the information that is stored on the sensors. 传感器设置—这些允许你改变存储在传感器上的信息。
- Security and passwords 安全和密码

The majority of these options can be setup using QuickTalk's graphical user interface, although some of the options require you to use the Terminal Mode to set them up using text based commands. 这些选项大都可通过使用 QuickTalk 图形用户界面设置，尽管有些选项需要你使用终端模式将它们用基于文本的指令给予设置。

Station Parameter Selection 台站参数选择

In the station parameters, the most important setting is which channels to record. More detailed information is available in the *Using QuickTalk & QuickLook Software User's Guide*, including material on the location and identification of the unit. See the *Setting Station Parameters* section of the *QuickTalk* manual to complete the setup. 在台站参数里，最重要的设置是哪一条通道记录。更详细的信息包括关于仪器的场所和识别均可在 *QuickTalk & QuickLook 软件使用指南* 中了解。为了完成设置，请参考 *QuickTalk* 手册中 *Setting Station Parameters 设置台站参数* 一节。

SELECTING CHANNELS TO RECORD 配置记录通道

Although the K2 may have four, six or twelve channels and the Makalu three or six channels, you may not need to record them all for a given experiment. Select only those channels connected to sensors that are active in a specific experiment — otherwise you will be wasting the recorder's memory on unwanted data. 虽然 K2 可以有 4、6 或 12 通道和 Makalu 有 3 或 6 通道，但对于一个给定的实验你无需记录它们全部。只选择那些连接有传感器在该特定实验中起作用的通道即可，——否则你将为记录无用的数据浪费记录器内存。

Stream Parameter Selection 数据流参数选择

The most important decision is what data to record and at what data rate. This is a trade-off between the bandwidth of the data and both the number of minutes of data you can record and how long the event will take to retrieve over a telephone line or other communications link. To complete the setup, refer to *Setting Stream Parameters* in the *Using QuickTalk & QuickLook Software User's Guide*. 最重要的决定是用什么数据率记录什么数据。这是数据带宽与你能记录的数据分钟数量及将通过电话线或其它通信链路回收取得的事件有多长两者之间的一个权衡。为了完成此设置，请参考 *QuickTalk & QuickLook 软件使用指南* 中的 *Setting Stream Parameters 设置数据流参数* 一节。

RECORDED DATA RATE 记录数据采样率

The sampling rate you wish to record depends on the bandwidth of the signal you are interested in and the frequency response of the sensors connected to

your system. The "useable" bandwidth of the instrument is 40% of the sampling rate. For example, at 100 samples per second (sps) you can record signals in the 0-40 Hz range, with 200 sps 0-80 Hz, and with 250 sps 0-100 Hz. A further restriction is the bandwidth of the sensor you are using. If it is limited to 20Hz it would have no value recording at 200 or 250 sps as the sensor limits the bandwidth. Historically, strong motion recording has been at 200 sps, while seismological recording has often used the 100 sps rate. Obviously, an event file recorded at 200 sps will be almost twice as long as one recorded at 100 sps and will take almost twice as long to transfer over a communications link. You must evaluate this trade-off. 你所要求的记录采样率取决于你感兴趣的信号带宽和连接到你的系统的传感器的频率响应。仪器的“可用的”带宽是采样率的 40%。例如，在每秒 100 采样(100sps)时你能够记录 0-40Hz 范围的信号，而对 200sps 则为 0-80Hz，对 250sps 则为 0-100Hz。更进一步的约束是你所使用的传感器的带宽。如果该传感器带宽限制在 20Hz，那它用 200 或 250sps 来记录也是毫无价值的。从历史观点上说，强震动记录有过 200sps 的，而地震记录则常用 100sps 的采样率。显然，一个用 200sps 记录的事件文件几乎是用 100sps 记录长度的两倍，并且通过通讯链路传输也要几乎多两倍。你必须估计这个权衡。

Note: 200 samples per second was used historically when the instrument's effective bandwidth was limited by the roll off of the analog anti-alias filters. For a 200 Hz sampling rate the filter cut off was normally 50 Hz. With a digital anti-alias filter the cutoff at 200 Hz samples will be 80 Hz, a much higher effective bandwidth.

注释： 每秒 200 采样在过去是用在仪器有效带宽受模拟 anti-alias 滤波器通频带平段截止的限制时。对于 200Hz 采样率，模拟滤波器截断频率通常是 50Hz。用数字 anti-alias 滤波器，其截断频率在 200Hz 采样时将是 80Hz，这是非常高的有效带宽。

Supported sampling rates are 20, 40, 50, 100, 200 and 250 sps. 支持的采样率是 20、40、50、100、200 及 250sps。

PRE-EVENT TIME 事件前时间（事件前存储时间，秒）

The setting allows you to determine how many seconds of data before the trigger criteria were met will be recorded in the event file. For strong motion applications this is normally set to a few seconds so you can determine the noise before the start of the event. The factory default is ten seconds. 此设置允许你确定拟记录在事件文件里满足触发标准之前的数据要多少秒数，亦即触发前存储的缓冲数据，又称事件前存储时间（以秒计）。对于强震动应用，通常设置十数秒钟以供你确定事件前的噪声即可。工厂设置默认值是 10 秒钟。

For weak motion recording, especially if you expect the system to be triggered on the S-waves, the situation is more complex. In this case, the pre-event should be sufficiently long to allow any P-waves from an event within the region of interest to be recorded. This time can be estimated by the travel times of the P and S waves from the most distant point of interest. The difference

between these times, with some allowance for a true pre-event time, gives the setting for the pre-event time. The maximum allowed setting is dependent on the amount of RAM in the recorder and the number of channels being recorded. A table showing the maximum settings is contained in the *Using QuickTalk & QuickLook Software User's Guide/QuickLook* manual in the *Setting Stream Parameters* section. 对于弱震记录，特别是如果你指望系统由 S 波触发，则此情况更为复杂。在此场合，事件前时间应该有足够地长以允许来自所感兴趣地区的事件的任何 P 波都能被记录到。该时间可以从感兴趣的最远点由 P 波和 S 波的走时来估计。可用这两者时间之差额加上少许宽容作为真实的事件前时间，给出事件前时间的设置。这最大允许的设置取决于记录器里 RAM 的总量和进行记录的通道数。关于出示最大设置的列表包含在 *Using QuickTalk & QuickLook Software User's Guide* 使用指南 / *QuickLook* 手册里的 *Setting Stream Parameters* 节中。

POST EVENT TIME 事件后时间（事件后保持时间，秒）

The post event time determines how many seconds after the system has de-triggered will be recorded in the file. It also determines how likely events are to be split into separate files. This is because if the system re-triggers during the post event the file will just be extended. If the post event is set too short, several files could be created from the same event. We set the factory default at ten seconds, which is a reasonable value for strong motion recording. For weak motion recording this time should be set according to the goals of the study. Generally, a time of 30 seconds or more should be considered. 事件后时间确定在系统停止触发后仍拟记录在文件里的时间有多少秒数。它也确定多少可能事件分开进入各自单独的文件。这因为如果在事件后时间内系统再触发时该记录文件只是将被延长。而如果事件后时间设置得太短，则从同一事件中有可能创建几个文件。我们设置这工厂默认值为 10 秒，它对于强震动记录是合理的。对于弱震动记录该时间则应按照研究目的去设置。一般说，应考虑为 30 秒或更多时间。

MINIMUM RUN TIME 最短运行时间

This is the minimum time the recorder will record once an event is triggered. Formerly, it was used to ensure a complete sequence of time code was recorded with the event, but this is not required anymore. Generally, the pre-event and post-event now give sufficient control over the event timing. For this reason we set the factory default to zero seconds. 这是一旦事件触发记录器将记录的最短时间。过去，它是用来保证随事件记录一个完整的时间代码的，但是现在不再需要了。一般说，现在事件前和事件后时间已对事件计时从头到尾给出了足够的控制。由于这个道理，我们设置这工厂默认值为 0 秒。

Channel Triggering 通道触发

Although you will need to read most sections to determine what is appropriate for your application, we have split the triggering system into two sections. If you are just interested in recording "strong motion" events when the ground or structure shakes significantly, you will find instructions on setting triggers in the *Triggering for Strong Motion Recording* section. If you are interested in

recording weak events that are very close to the local seismic noise, you should read *Triggering and Recording Weak Motion Applications*. After you read the relevant section you will be able to set up each channel's triggering appropriately for your application. The triggering should be set up using the *Using QuickTalk & QuickLook Software User's Guide Setting Channel Parameters* section. 虽然你将阅读许多章节以确定对你的应用而言什么是合适的，我们现将触发系统分别写进了两节。如果你只是对记录当地面或结构明显震动时的“强震动”事件感兴趣，你将可在 *Triggering for Strong Motion Recording* 强震动记录用的触发节里找到相关设置触发器的指示。如果你感兴趣记录非常接近于当地地震噪声的弱震事件，你应该阅读 *Triggering and Recording Weak Motion Applications* 弱震动应用的触发和记录节。在你读完相关章节后，你将能设置适合你使用的各通道触发参数。请参考 *Using QuickTalk & QuickLook Software 使用指南* 中的 *Setting Channel Parameters* 节。

Triggering in Strong Motion Applications 强震动应用的触发

For strong motion recording you will want to record the strongest motion from an earthquake that can be felt and possibly cause damage to buildings and other structures. Normally, a simple threshold trigger will be sufficient to reliably trigger the recorder. As these are sensitive instruments, it is also possible to record much weaker motions using the threshold trigger. The tradeoff to consider is how you will retrieve the data and how to ensure that there will be room for the "big one" if you have very sensitive threshold trigger levels. 对于记录强震动你将从一个有感的和可能产生建筑物、结构物损坏的地震记录最强的震动。通常地，一个简单的阈值触发器就足够作为记录器的可靠的触发器了。就灵敏的仪器而言，使用阈值触发器记录许多弱震动也是可行的。如果你用非常灵敏的阈值触发水准，考虑权衡是你将回收的数据有多少和如何保证将会有为“big one”的空间。

The threshold trigger has two parameters for each channel. The first is the threshold trigger, which is the level in percent of full scale that causes the channel to trigger. The default value for this is 2%. The second parameter is the threshold de-trigger. This is the value in percent of full scale the signal must fall below after triggering for the channel to dettrigger. The default value is 2%. The dettrigger parameter can be used for extending the recording time by setting it to a smaller value than the threshold trigger value. 阈值触发器对每个通道有两个参数。第一个参数是触发阈值，它是导致通道触发的水准（标准），以满量程的百分比计。此默认值为 2%。第二个参数是停止触发阈值。这是在触发之后信号必须降到该值水平之下以使通道停止触发，以满量程的百分比计。其默认值为 2%。将停止触发参数设置成一个比触发阈值量值要小的值就能够被用来延长记录时间。

For strong motion recording you will normally select the non-causal final filter for the final FIR anti-aliasing filter. The non-causal filter has a linear phase response that is equivalent to a pure-time delay, and the phase of the acceleration signal is undistorted. This is the default setting for the final filter. 对于强震动记录通常地你将选用非诱导最终滤波器作为最终有限脉冲响应 FIR anti-alias 滤波器。这非诱导滤波器有线性相位响应，即是等价于纯

时间延迟，并且加速度信号的相位是不失真的。这是最终滤波器的默认设置。

ALARMS 警报器

The recorder has an additional set of thresholds called alarm threshold parameters. These are specified as a percentage of the full-scale input and can be set independently for each channel. They are set in the channel trigger parameters window. When a channel's triggered filtered data exceeds this threshold, the hardware alarm is activated and if the unit is in block communication mode a status packet is sent with the alarm indicator set. The hardware alarm output is available as a CMOS-compatible signal on the auxiliary connector. (See Chapter 6 for more information.) 记录器有称为报警阈值参数的附加阈值设置。这些阈值是以满量程输入的百分数指定的，并且对每个通道能独立地设置。它们是设置在通道触发参数窗口中的。当一个通道的触发滤波数据超出该阈值时，硬件警报器即动作，并且如果仪器处于块通信模式时随着报警指示器设置将送出一个状况信息包。该硬件警报器输出是可用作为在辅助连接器上的一个 CMOS-兼容信号。

Triggering in Weak Motion Applications 弱震动应用的触发

The recorder includes the following features for use in seismological applications: 对于地震学的应用记录器包含下列特性：

- The ability to select causal FIR filters for digitized data that have no precursors that can affect phase picking. 有能力对于数字化的数据选择诱导有限脉冲响应 causal FIR 滤波器，它没有可以影响相位提取的先兆。
- Three different trigger filters that allow the trigger band of interest to be optimized. 有三个不同的触发滤波器可允许优选感兴趣的触发带宽。
- STA/LTA triggering to support the recording of small amplitude events. 采用 STA/LTA 触发方式支持记录小振幅事件。

The use of these specific features is discussed below. 下面讨论这三个特性的利用。

CAUSAL FILTERS 诱导滤波器

The recorder has a two-stage high-order anti-aliasing filter system that offers extremely steep ("brickwall") roll-off combined with decimation of data. You can select between the causal or non-causal versions of these filters depending on your application. 记录器有一个 2-级高阶 anti-alias 滤波系统，它用数据筛选办法提供通频带极为陡峭的平段截止结合处("brickwall")。你可以按照你的应用需要在滤波器的诱导或非诱导两种方式之间选取。

Use the final causal filter for precise seismic phase picking (this type of filter does not generate precursors that might interfere with determining the precise onset time). Use the non-causal final filter to avoid phase distortion of the

signal. 为了精确的地震相位提取请使用最终诱导滤波器(此型滤波器不产生可以干扰确定准确的初始时间的先兆)。若为避免信号的相位失真则请使用非诱导最终滤波器。

The non-causal filter has a linear phase response that is equivalent to a pure-time delay, and the phase of the seismic signal is undistorted. Therefore, there is no need for de-convolution of seismic signals when using these filters if you are primarily concerned with phase distortion. The degree to which their pass-band amplitude characteristics modify seismic signals is tolerable in most seismological applications. 非诱导滤波器有等价于纯时间延迟的线性相位响应, 并且地震信号的相位是不失真的。因此, 如果你主要关注相位失真当, 使用此类滤波器时可无需顾忌如何消除地震信号相位失真问题。至于滤波器的通带振幅特性对地震信号影响的程度在大多数地震学应用中是可以容许的。

ASCII files containing the coefficients of all these filters can be downloaded from the Kinometrics Web site or at <ftp://ftp.kinometrics.com>. 包含所有这些滤波器系数的 ASCII 文件可从 Kinometrics Web 网址或在 <ftp://ftp.kinometrics.com> 上下载。

Configure causal FIR filtering as follows: 配置诱导 FIR 滤波如下:

Start *QuickTalk*. 启动 *QuickTalk*.

1. Select **Recorder** and **Acquisition Control**, then click on **Edit Parameters**. The Edit Parameters dialog box appears. 选择 **Recorder**(记录器)和 **Acquisition Control**(获取控制), 然后点击 **Edit Parameters**(编辑参数)。Edit Parameters 对话框呈现。
2. Click on **From Recorder** or **From Disk** to specify the source of the parameter file you want to edit. 点击 **From Recorder**(源自记录器)或 **From Disk**(源自磁盘)以指定你要编辑的参数文件的来源。
3. Click on **Streams**. The Stream Parameters dialog box appears. 点击 **Streams** (数据流)。Stream Parameters 对话框呈现。
4. Select **Causal** in the final Anti-Alias Filter selection box. This will select a filter with a bandwidth of 40% of the sampling frequency and an asymmetrical impulse response with no ringing before the signal, but more ringing after the impulse. 在 final Anti-Alias Filter(最终 Anti Alias 滤波器)选择栏内选择 **Causal** (诱导)。这将选择具有带宽为采样频率的 40% 的滤波器, 并且具有信号之前没有反应而脉冲之后即反应的不对称脉冲响应。
5. Click on **OK**, then save the parameters file to the recorder (or to disk, if you plan to install the parameters file on the recorder later). 点击 **OK**(同意), 于是保存参数文件到记录器(或保存到磁盘, 如果你计划稍后安装参数文件到记录器的话)。

Or, enter these parameters in the Terminal Window Parameter Editor with the **Stream Filter** command. Refer to the *Using QuickTalk & QuickLook Software User's Guide* for more information.

或者，用 **Stream Filter** 命令将这些参数输入到 Terminal Window Parameter Editor(终端窗口参数编辑器)中。为取得更多信息请参考 *Using QuickTalk & QuickLook Software User's Guide 使用指南*。

TRIGGER FILTERS 触发滤波器

Your selection of a pre-trigger filter is determined by your application, by seismic noise conditions at the site, and by the type of sensors installed with the recorder. The pre-trigger filter pass-band should encompass the maximum energy of expected seismic events. The filter you select should have a pass-band that doesn't coincide with the peak frequency components of seismic noise at the site, thus discriminating against seismic noise (see Figure 19). 你的预触发滤波器的选择是由你的应用、仪器所在场地地震噪声环境以及与记录器配用的传感器的类型所决定的。该预触发滤波器通带应包含预期地震事件的最大能量。你所选择的滤波器的通带应该与仪器场地地震噪声的峰值频率分量不相符合，从而可识别地震噪声(见图 19)。

Figure 19: Typical trigger filter response

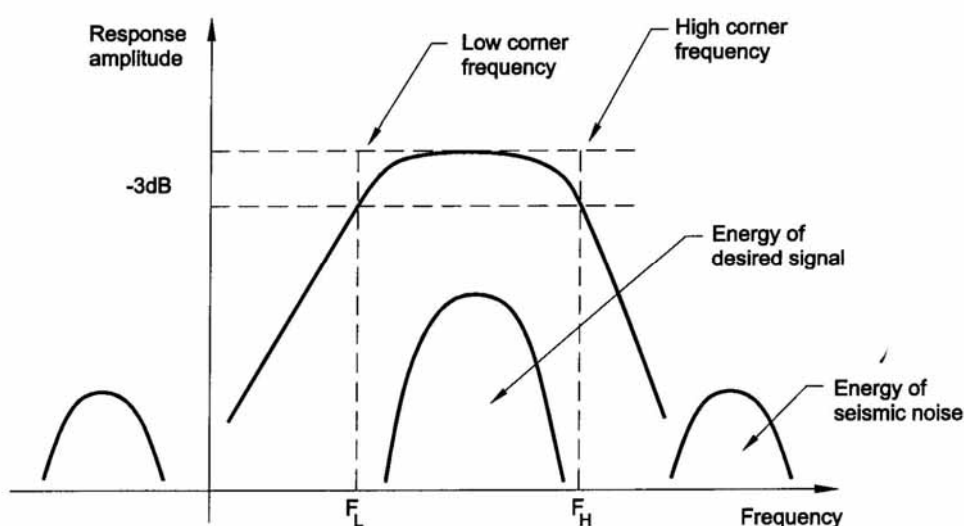


图 19 典型的触发滤波器响应

The frequency response function of the seismic sensor modifies event and noise signals and thus is an important factor in your choice. If the frequency content of events and of seismic noise occur in the same frequency band, the trigger filter will be inefficient. 地震传感器的频响函数改变了事件和噪声信号，因而在你的选择中是一个重要的因子。如果满足事件的频率与满足地震噪声的频率都出现在同一频带内，那这触发滤波器将是不能胜任的。

The recorder has three band-pass filters with different low- and high-corner frequencies. Note that the corner frequencies scale according to the sampling rate. Some examples are as follows: 记录器有着三个具有不同的低的和高

的转角频率的带通滤波器。注意这些转角频率是按照采样率规定的。现举例如下：

- An IIR-A filter with a 100 Hz sampling rate can record regional events with broadband sensors. Its 0.6 Hz low-corner frequency gives some protection to the dominant component of natural marine seismic noise. Its high-corner frequency gives protection against excessive high-frequency man-made seismic noise. 一个 IIR-A 滤波器用 100Hz 采样率能与宽带传感器连用记录区域事件。滤波器的 0.6Hz 低转角频率能对自然界海上地震噪声的优势分量给予一些保护。而其高转角频率则对抵抗额外的高频人为地震噪声给予保护。
- An IIR-A filter with a sampling rate of 200 or 250 Hz can monitor local earthquakes with efficient protection against marine noise. 一个 IIR-A 滤波器用 200 或 250Hz 采样率能监测地方震并具备有效保护抵抗海上噪声的能力。
- The classic strong motion filter at a sampling rate of 200 Hz or 250 Hz is used in typical strong motion applications. 在典型的强震动应用中可用 200Hz 或 250 Hz 采样率的经典强震动滤波器。
- The low-frequency corner of a classic strong motion filter at a sampling rate of 100 Hz can be used for far-regional and tele-seismic applications. It has good protection against 20 - 40 Hz man-made seismic noise in urban areas. 用 100Hz 采样率的经典强震动滤波器的低频转角可被用为遥远地区和遥测地震应用。它在城市地区对抵抗 20-40Hz 人为地震噪声有着很好的保护作用。
- The classic strong motion filter at a 250 Hz sampling rate can record for short periods with a short-period seismometer. In this case, the sensor itself protects against ~0.3 Hz marine seismic noise. 用 250 Hz 采样率的经典强震动滤波器与短周期地震计连用能记录短周期振动。在这种场合，传感器本身就能对抵抗 ~ 0.3Hz 的海上地震噪声起到保护。
- An IIR-C filter at a 200 or 250 Hz sampling rate can monitor local earthquakes. However, there is no protection against high-frequency man-made noise because the frequency content of the events and the noise is approximately the same. 一个 IIR-A 滤波器用 200 或 250 Hz 采样率时可以监测地方震。然而对于抵抗高频人为噪声没有保护作用，因为满足事件的频率与噪声频率大致相同。

The approximate band-pass of these filters is shown in the table below. 这些滤波器的带通近似值列于下表中。

Table 2: Trigger types and sampling rates

Trigger Type	20 SPS	40 SPS	50 SPS
IIR-A	~ 0.12-2 Hz	~ 0.24-4 Hz	~ 0.3-5 Hz

表 2 触发器型式和采样率

Classic Strong Motion	~ 0.01-1.25 Hz	~ 0.02-2.5 Hz	~ 0.025-3.125 Hz
IIR-C	~ 0.2-4 Hz	~ 0.4-8 Hz	~ 0.5-10 Hz
Trigger Type	100 SPS	200 SPS	250 SPS
IIR-A	~0.6-10Hz	~1.2-20Hz	~1.5-25Hz
Classic Strong Motion	~0.05-6.25Hz	~0.1-12.5Hz	~0.12-15Hz
IIR-C	~1-20Hz	~2-40Hz	~2.5-50Hz

To select these filters refer to the *Setting Channel Parameters* section of the *QuickTalk & QuickLook User's Guide*. 为选择这些滤波器请参考 *QuickTalk & QuickLook User's Guide 使用指南* 的 *Setting Channel Parameters 设置通道参数* 一节。

STA/LTA TRIGGERING 长短时平均触发

Purpose 目的

The short-time average/long-time average (STA/LTA) trigger algorithm generally increases the sensitivity of the recorder in comparison to the amplitude threshold trigger algorithm. It improves the earthquake triggers/false triggers ratio, and, to some extent allows discrimination among the different types of earthquakes. 短时平均/长时平均触发算法通常比振幅阈值触发算法增加记录器的灵敏度。它改善了地震触发与误触发的比率，并且，可以有某些程度许可识别不同类型的地震。

This can minimize the work of analysts and allows more efficient use of the recorder's data memory. Therefore, STA/LTA triggering is used most often in weak motion applications that try to record as many seismic events as possible. The STA/LTA trigger parameter settings are always a tradeoff among several seismological and instrumental considerations – the highest possible trigger sensitivity for a given type of earthquakes (including "all earthquakes") at a tolerable number of false triggers. 这能将分析工作减到最小，并允许更有效地利用记录器的数据内存。因此，STA/LTA 触发方式是最常用在试图记录尽可能多的地震事件的弱震应用方面。STA/LTA 触发参数的设置始终是在几个地震学的和仪器的须考虑事项之中的一个权衡，即在可容忍误触发数量的条件下为一个给定型式的地震(包括“所有地震”)提供最大可能的触发灵敏度。

STA/LTA triggering is most beneficial at seismically quiet sites where natural seismic noise (marine noise) is the dominant type of seismic noise. 在自然地震噪声(海上噪声)为地震噪声的支配型式状况的地震平静场所，STA/LTA 触发方式是最有效的。

STA/LTA triggering is also effective in cases of suddenly changing man-made seismic noise (like the noise due to day/night variation of human activity in or close to an urban area). The STA/LTA algorithm is less effective in the presence of irregular, high amplitude man-made seismic noise that is often of the burst and/or spike type. 在突然变化人为地震噪声(像由于在市区内或

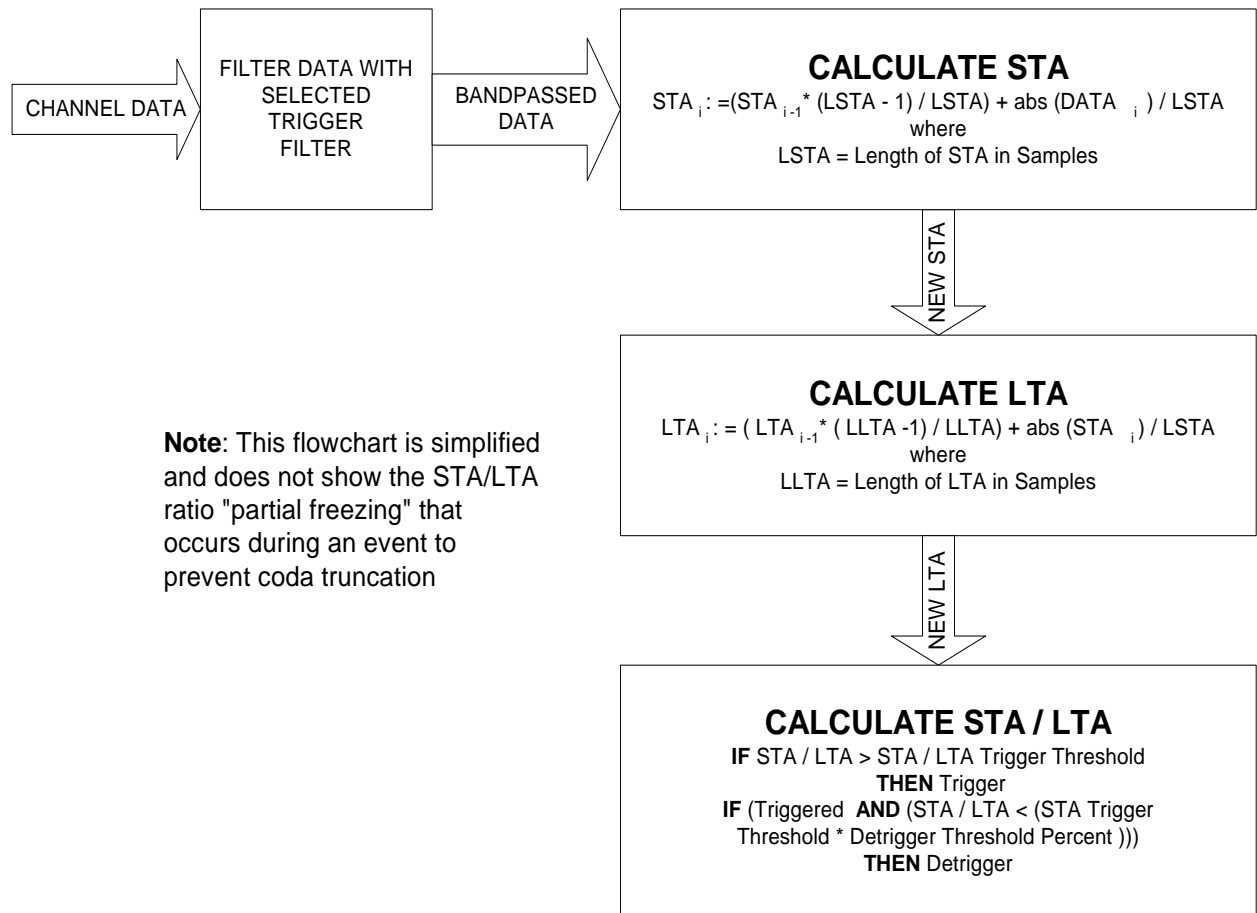
市郊人类活动的日/夜变化引起的噪声)场合，STA/LTA 触发方式也是有效的。而在常有突发脉冲和/或尖钉型式那类不规则的、振幅高的人为地震噪声存在的场合，STA/LTA 算法效果较差。

How STA/LTA Works STA/LTA 如何工作

The STA/LTA algorithm continuously follows the changes in seismic noise over time, and automatically adjusts recorder sensitivity to give you optimal sensitivity to the actual seismic noise level at a specific time. This results in significantly higher sensitivity during seismically quiet periods. 在地震噪声随着时间过去 STA/LTA 算法不断地跟随着变化，并且自动地调整记录器灵敏度以对于在特定时间的实际地震噪声水准给出你最佳的灵敏度。这导致了在地震平静周期的齐建民县较高的灵敏度。

The STA/LTA algorithm calculates average absolute amplitude of a seismic signal in two time windows – a Short Time Average window (STA) and a Long Time Average window (LTA). The short time average window (STA) "watches" for earthquakes and measures the "instant" amplitude of the seismic signals. The long time average window (LTA) takes care of the average value of seismic noise during the same period of time. A ratio of both values – the STA/LTA ratio – is continuously calculated and, if it exceeds the preset STA/LTA trigger threshold level, a channel trigger is declared. The channel de-triggers if the STA/LTA ratio falls below another pre-set value – the STA/LTA de-trigger threshold level. STA/LTA 算法计算在两个时间窗内地震信号的平均绝对振幅—短时间平均窗(STA)和长时间平均窗(LTA)。短时间平均窗(STA)“监视”地震并测量地震信号的“即时”振幅。由长时间平均窗(LTA)可获得在同样时间期间地震噪声的平均值。这两者之比—STA/LTA 比—是不断地被计算着，并且如果它超出预置的 STA/LTA 触发阈值水准，通道触发器启动。如果 STA/LTA 比降低到另一个预置值—STA/LTA 停止触发阈值水准之下则通道停止触发。

STA/LTA trigger ratio calculations are calculated according to the steps in Figure 20. All calculations are made for every data sample in every channel in the recorder, assuring minimal time delay between the seismic event and the triggering. STA/LTA 比计算是按照图 20 中的步骤执行的。对于记录器每个通道里的每个数据采样做所有计算，保证地震事件和触发之间的最小时间延迟。

Figure 20: Simplified flowchart of STA/LTA calculations**图 20 STA/LTA 计算流程简图****STA/LTA Parameters STA/LTA 参数**

To set the STA/LTA trigger algorithm, adjust the following parameters: 为设置 STA/LTA 触发算法，请调整下列参数：

- STA window duration in seconds STA 窗持时，以秒计
- LTA window duration in seconds LTA 窗持时，以秒计
- STA/LTA trigger threshold level STA/LTA 触发阈值水准
- STA/LTA de-trigger threshold level STA/LTA 停止触发阈值水准

Adjusting STA/LTA Trigger Parameters 调整 STA/LTA 参数

The STA/LTA trigger parameter settings depend on the goals of the application, seismic noise conditions, and the properties of earthquake signals at a given

location. Each seismic site requires detailed study, and only experience will enable you to determine optimal trigger settings. STA/LTA 触发参数设置取决于应用的目标、地震噪声状态以及所在地区的地震信号特性。每一个地震场地都需要仔细研究，通常仅以经验确定最佳的触发设置。

In general, by proper adjustments of the STA and LTA duration, you can make triggering more or less sensitive to certain type of earthquakes, and less sensitive to the type of seismic noise at a given site. 总之，对 STA 和 LTA 持时恰当地调试可以对于某些地震做到触发更灵敏或低灵敏，并可在给定场地对地震噪声类型触发低灵敏。

Short Time Average Window (STA) Duration 短时间平均窗(STA)持时

The short time average window (STA) duration works as a kind of filter. The shorter it is, the more sensitive the STA/LTA trigger will be to short and high frequency signals of local earthquakes. It will also be less sensitive to distant earthquakes. The longer the STA duration, the less sensitive the trigger will be for short local earthquakes. By changing the STA duration you can prioritize to some extent between distant or local events. 短时间平均窗(STA)持时作为一种滤波器工作。当它较短，则 STA/LTA 触发器将对地方震短的高频信号更灵敏。它也将对远距地震降低触发灵敏度。当 STA 持是较长，则对短的地方震触发器降低灵敏度。用改变 STA 持时可在某种程度上把远距或地方事件之间列入优先地位考虑。

On the other hand, by increasing the duration of the STA window, for example, triggering becomes less sensitive to the common spike-type of man-made seismic noise, **and vice versa**. 另一方面，增加 STA 窗持时，例如，对于通常的尖脉冲类型人为地震噪声将降低触发灵敏度。

For regional events, a typical initial value of STA duration is 1 second, for local events shorter values of around 0.3 s are most commonly used. 最通常采用对于地区事件建议 STA 持时初设值为 1 秒，而对于地方事件则建议 STA 持时初设值为 0.3 秒。

Long Time Average Window (LTA) Duration 长时间平均窗(LTA)持时

By setting the LTA window, you can make recording more or less sensitive to regional events with typically slowly emergent onset waves. In the case of a short LTA duration, you allow the LTA value to follow the slowly increasing amplitude of emergent seismic waves and this results in a decreased STA/LTA ratio at the moment when the S waves arrive, thus reducing trigger sensitivity. In the opposite case, using a longer LTA duration, the sensitivity to emergent earthquakes will increase because the STA/LTA ratio will not be influenced so rapidly by the emergent seismic signal. 用设置 LTA 窗，可以对于具有典型地缓慢浮现的初始波的地区事件做到触发记录更灵敏或低灵敏。在短 LTA 持时场合，可允许 LTA 值跟随浮现地震波的振幅缓慢增长并在地震 S 波到达的瞬间导致减少 STA/LTA 比值，因而降低触发器灵敏度。在相反的场所，用较长的 LTA 持时，对于突现地震的灵敏度将因为 STA/LTA 比值不会如此快速地感受突现地震信号所影响而增加。

On the other hand, a short LTA will adjust recorder sensitivity to relatively fast changes in "continuous" man-made seismic noise during night-to-day transitions of activity in urban areas. Natural seismic noise (marine noise) changes much more slowly and therefore much longer LTA durations can be used. 另一方面，短 LTA 将调节记录器灵敏度以相对快速变更城市区域活动由于夜晚到白天的转换引起的“连续”人为地震噪声。自然地震噪声（海洋噪声）变化更慢，因而可用更长的 LTA 持时。

An LTA duration of 60 seconds is a good initial value. A shorter LTA duration is needed to exclude emergent regional events or to reject changing man-made noise at the site. LTA 持时用 60 秒是好的初设值。为了排除突现区域地震或为了抵制在场地上变化的人为噪声需要用较短的 LTA 持时。

The recorder has a modified version of a "frozen" long time average window (LTA) during events. The LTA value is, to the first approximation, not allowed to change (increase) during an event. This prevents truncation of coda waves due to the LTA increasing too rapidly during events (and thus decreasing STA/LTA ratio too rapidly). However, this "freezing" is not complete, allowing the trigger algorithm to prevent the unit from being permanently triggered by a rapid increase in seismic noise. 在事件期间记录器具有“冻结”的长时间平均窗(LTA)的修订版本。对于第一次近似，当事件期间 LTA 值不允许改变（增加）。这防止由于 LTA 在事件期间增长太快（并因而减低 STA/LTA 比值太快）而引致 coda 波遭截断。然而，此“冻结”是不完全的，允许触发算法防止该单元由于地震噪声快速增加引致永久被触发的局面。

STA/LTA Trigger Threshold Level STA/LTA 触发阈值水平

The optimal STA/LTA trigger threshold ratio depends mainly on seismic noise conditions at the site. Higher noise levels, particularly the man-made kind, require higher values. Higher values result in fewer false triggers but miss more earthquakes. Lower STA/LTA triggers make the station more sensitive but cause more false triggers to be recorded. False triggers and missed events are an unavoidable reality when recording seismic signals in event triggered mode. 理想的 STA/LTA 触发阈值比主要取决于所在场地的地震噪声状态。较高的噪声水准，特别是人为类型的，需要较高的值。较高值导致很少虚假触发但丢失很多地震。较低的 STA/LTA 触发值使台站更灵敏但也会产生更多的虚假触发记录。虚假触发和丢失事件在以事件触发方式记录地震信号时是不可避免的现实。

An initial setting of 4 for the STA/LTA ratio is common for relatively quiet seismic sites. Higher values of 8 and above are required at less favorable sites where man-made seismic noise is present. 对于地震相对平静的场址通常将 STA/LTA 比值初设为 4。对存在人为地震噪声的不利场所则应将 STA/LTA 比值需要较高值，设在 8 和更多。

STA/LTA De-Trigger Threshold Level STA/LTA 去触发阈值水平

The STA/LTA de-trigger threshold level (along with the post-event time parameter) determines when the recording will terminate. The de-trigger threshold is determined through a selectable STA/LTA de-trigger threshold percentage parameter and the current STA/LTA trigger threshold value. For

example, a STA/LTA de-trigger threshold level of 4 at an STA/LTA trigger threshold level of 8 is obtained by selecting the STA/LTA de-trigger threshold percentage of 50%. STA/LTA 去触发阈值水平（和事件后时间参数一起）决定何时记录将终止。透过一个可选的 STA/LTA 去触发阈值百分比参数和现有 STA/LTA 触发阈值可确定去触发阈值。例如，STA/LTA 触发阈值水平为 8，STA/LTA 去触发阈值百分比参数为 50%，STA/LTA 去触发阈值则为 4。

The STA/LTA de-trigger threshold level determines how well the coda waves of recorded earthquakes will be captured. To preserve complete coda waves, low values are required. On the other hand, if one is not interested in coda waves, significant savings in memory are possible if high values of STA/LTA de-trigger threshold levels are used. An STA/LTA de-trigger threshold percentage of 100% is the highest value possible. It makes the STA/LTA trigger threshold level and the STA/LTA de-trigger threshold level equal. STA/LTA 去触发阈值水平确定将如何很好地获取所记录地震的 coda 波。为维持完整的 coda 波，需要低的 STA/LTA 去触发阈值水平。另一方面，如果对 coda 波不感兴趣，若用高的 STA/LTA 去触发阈值水平，有效的节省存储容量是可能的。STA/LTA 去触发阈值百分比为 100% 是可能的最高值。它使 STA/LTA 触发阈值水平与 STA/LTA 去触发阈值水平相等。

In general, the noisier the site, the higher the value of the STA/LTA de-trigger threshold level that must be used to prevent continuous, repeated re-triggering. This danger is particularly high at sites heavily polluted by man-made seismic noise. 总之，对于噪声较大的场地，必须用较高的 STA/LTA 去触发阈值水平以防止连续的重复再触发。在受到人为地震噪声严重污染的场所这种危险尤其高。

The recorder will always use an STA/LTA de-trigger threshold level of at least 1.2. For example, if you select a 10% de-trigger threshold with the STA/LTA trigger threshold level of 4, you would theoretically get 10% of 4 or 0.4 and the unit would be continuously triggered. However, the recorder automatically uses a minimum STA/LTA de-trigger threshold level of 1.2 to prevent this continuous triggering. 记录器将常常使用至少 1.2 的 STA/LTA 去触发阈值水平。例如选择去触发阈值百分比为 10% 及 STA/LTA 触发阈值水平为 4，理论上将可得到 4 的 10%，或 0.4，并且该单元总是会连续触发。可是，记录器自动地用一个最小的 STA/LTA 去触发阈值水平 1.2 就可以防止这种连续触发。

A typical initial value of the de-trigger threshold is 2 to 3. The percentage set must be calculated taking into account the current STA/LTA trigger threshold value. For example with an STA/LTA trigger threshold of 4, and a desired STA/LTA de-trigger threshold of 2 you would need to set an STA/LTA de-trigger threshold percentage of 50%. 去触发阈值推荐的初设值为 2 到 3。必须取现有 STA/LTA 触发阈值计算百分数设置。例如，用 STA/LTA 触发阈值为 4，而期望的 STA/LTA 去触发阈值是 2，则将需要设置 STA/LTA 去触发阈值百分数为 50%。

STA/LTA trigger algorithm default parameters are: STA/LTA 触发器算法缺省参数是：

- STA/LTA 去触发阈值百分数=40%，产生有效的 STA/LTA 去触发
阈值水平为 1.6

As the configuration of STA/LTA triggering requires several entries we will go through the procedure below. You should also refer to the *Setting Channel Parameters* section of the *QuickTalk and QuickLook User's Guide*. Proceed as follows: 为了配置 STA/LTA 触发器需要几个入口通道，我们将通过下面步骤去做。你还应参考 *QuickTalk and QuickLook User's Guide 手册内 Setting Channel Parameters* 节。继续如下：

1. Start 启动 *QuickTalk*.
2. Select **Recorder** and **Acquisition Control**, then click on **Edit Parameters**. The Edit Parameters dialog box appears. 选择 **Recorder** 记录器和 **Acquisition Control** 获取控制，然后点击 **Edit Parameters** 编辑参数。该参数编辑对话框呈现。
3. Click on **From Recorder** or **From Disk** to specify the source of the parameter file you want to edit. 点击 **From Recorder** 从记录器或 **From Disk** 从磁碟以指定你需要编辑的参数文件源。
4. Click on **Channels**. The Channel Parameters dialog box appears. 点击 **Channels** 通道。通道参数对话框呈现。
5. Specify the channel for which you want to configure STA/LTA triggering in the *Edit Channel* field. 在 *Edit Channel* 编辑通道场内，指定你要配置 STA/LTA 触发的通道。
6. In the box labeled *Event Trigger*, select the **Filter** pull-down box. Select the appropriate trigger filter for the channel. 在标记有 *Event Trigger* 事件触发器的框内，选择 **Filter** 滤波器拉下框。为该通道选择适当的触发滤波器。
7. Now select the **Type** pull-down box. Select STA/LTA from the list. 现在选择 **Type** 类型 拉下框。从此表里选择 STA/LTA。

8. Specify the length of the short-term average time in seconds by picking one of the values from the **STA Length** list (the range is from 0.1 to 10 seconds). Only the values listed are allowed. 由 **STA Length 短时间平均长度表** (范围从 0.1 到 10 秒) 取出一个值, 指定为短项平均时间的长度以秒计。仅仅只允许表列出的值。
9. Specify the long-term average time in seconds from the **LTA Length** list (these range from 20 to 120 seconds). Only the values listed are allowed. 由 **LTA Length 长时间平均长度表** (范围从 20 到 120 秒) 指定长项平均时间的长度以秒计。仅仅只允许表列出的值。
10. Select the ratio of the STA/LTA that will cause the channel to trigger from the **STA/LTA Trig Ratio:** list. (These vary from a minimum of 1.5 up to 1000. The lower the value you select the more sensitive the unit and the more events you are likely to record.) Only the values listed are allowed. 选择 STA/LTA 比值, 从 **STA/LTA Trig Ratio 触发比:表** 将引致通道触发。(表列数据从最小 1.5 到 1000。若选此值较小, 则仪器更灵敏且你希望的记录获得更多。) 仅仅只允许表列出的值。
11. Set the **STA/LTA Detrig** from the selection list. This will determine how sensitive the channel becomes once it has triggered. Only the values listed are allowed. Remember this is a percentage of the STA/LTA trigger ratio. 从选择表中设置 **STA/LTA Detrig 去触发**。这将确定通道一旦被触发其灵敏如何。仅仅只允许表列出的值。记住这是 STA/LTA 触发比的百分数。
12. Repeat this for each channel that is active in the recorder's triggering scheme. 对每个通道重复如上, 那在记录器的触发图解里是活动的。
13. Click on **OK**. 点击 **OK 好**。
14. Click on **Streams**. The *Streams Parameters* dialog box opens. 点击 **Streams 数据流**。Streams Parameters 数据流参数对话框打开。
15. Enter the number of votes you want for each channel that you want to contribute to the triggering. Assign zero votes to the channels you do not wish to contribute to the triggering. You can also assign votes to the external and keyboard triggers. Finally, assign the trigger weight and the de-trigger weight, which are the number of votes needed to trigger and de-trigger the instrument respectively. (Refer to *Triggering Options*, for a discussion of triggers and trigger votes.) 对每个通道输入你要的票数, 它代表你期望对触发的贡献。分配零票给你不希望它对触发有贡献的通道。你也可分配一些票给到外部的和键盘触发器。最后, 分配触发权重和去触发权重, 那是为了触发和去触发仪器分别所需的票数。(为了讨论触发器和触发投票请参见 *Triggering Options 触发选项*。)
16. In this dialog box you also set the **Pre-Event**, **Post-Event**, **Min Run Time**, the **Sampling Rate**, and the type of **Final Anti-Alias** filter (causal or non-causal). 在此对话框里, 你还要设置 **Pre-Event 事件前**, **Post-Event 事**

件后, **Min Run Time** 最小运行时间, **Sampling Rate** 采样率, 和 **Final Anti-Alias** 滤波器 (诱导或非诱导) 类型。

17. Click on **OK**. 点击 **OK** 好。
18. Click on **Station**. The *Station Parameters* dialog box opens. 点击 **Station** 台站。 *Station Parameters* 台站参数对话框呈现。
19. In this dialog box put a check mark besides each Channel you wish to record and fill in details about the station and its location. 在此对话框里, 在你希望记录的每个通道旁添加一个检查标号, 并详细填写关于台站和其位置的信息。
20. Click on **OK**, then save the parameters file to the recorder (or to disk, if you plan to install the parameters file on the recorder later). 点击 **OK** 好, 然后保存参数文件到记录器 (或磁碟, 如果你计划稍后再安装参数文件到记录器的话)。

You can also enter these parameters in the Terminal window Parameter Editor with the **Channel Trigger Type**, **Channel STA**, **Channel LTA**, and **Channel Ratios** commands. (Remember that you must still specify how many triggered channels will trigger the unit with the **Stream Voters** command.) Refer to the *Using QuickTalk & QuickLook Software User's Guide* for more information. 你还可以用 **Channel Trigger Type** 通道触发类型, **Channel STA** 通道短时间平均, **Channel LTA** 通道长时间平均, 和 **Channel Ratios** 比值等命令输入这些参数到终端窗参数编辑器。(记住你仍必须用 **Stream Voters** 数据流票决命令指定将触发该单元的触发通道数量。) 若需更多信息请参见 *Using QuickTalk & QuickLook Software User's Guide* 手册。

Trigger Voting Parameters 触发表决参数

Each channel can be assigned a number of votes that it may cast towards getting the system to trigger. This is called "voting." How the voting system is set up is dependent on which signals you are trying to record and which you are trying not to record. You may need some first-hand experience with the conditions at the site before you can optimize this triggering. The parameters used to set up the triggering are explained below. They should be setup using the instructions in the *Using QuickTalk & QuickLook Software User's Guide* manual for *Setting Stream Parameters*. 每个通道被分配了一定的表决票数以确定系统是否触发, 我们称为“表决”, 如何设定表决系统, 依赖于你想记录什么信号和不想记录什么信号, 在你优化触发之前, 你需要第一手的关于场地情况的经验。用于设定触发的参数如下。这些参数可以通过 *QuickTalk* 和 *QuickLook* 通讯软件用户手册中的设置数据流参数设定。

CHANNEL WEIGHTS (TRIGGER/DETRIGGER VOTES)

通道权重 (触发/去触发表决)

The mechanics of this are relatively simple. You select the number of votes each channel will contribute (when it is triggered) to the total number of votes

required to trigger the system. Give zero votes to a channel that you *do not* want to affect the triggering. Give a positive number of votes to a channel you *do* want to contribute to the triggering. Give negative votes to a channel you wish to *inhibit* triggering. 给你不想影响触发的通道设为零，给你认为对触发有作用的通道较多的权数，而给你想禁止触发这种机理相对简单。你为每个通道选择的票数的总和将构成触发系统的总权数。的通道较少的权数。

TRIGGER WEIGHT 触发权重

This is the total number of votes required to get the system to trigger. 这是使系统触发需要的总票数。

KEYBOARD VOTES 键盘表决

If you want to trigger the unit from a keyboard for test purposes, give the keyboard trigger the same number of votes as the total trigger weight so that it will trigger the unit by itself (without any other channels being triggered). 如果由于检测的目的，你想用键盘触发系统，给键盘设定和触发系统所需权数同样多的权，在没有任何通道被触发时，敲一下键盘就能使系统触发。

EXTERNAL VOTES 外部表决

This is the number of votes you assign to the external hardware trigger source. If you want all units in the network to trigger when one unit triggers, assign it the same number of votes as the trigger weight. If you want to use a combination of an external trigger with other internal criteria, set the votes appropriately. 这是你对外部硬件触发源分配的票数。如果当一个单元触发时你想让网络上的所有单元都触发，给外部触发源分配与触发权相同的票数。如果你想使用外部触发与内部标准进行联合触发，则应恰当地设置票数。

EXAMPLES OF VOTING SCHEMES 表决方案实例

Classic Free-Field Site: Normally uses a three-channel internal EpiSensor with no interconnected units. Each channel has 1 vote and requires only 1 vote to trigger. Any channel could trigger the system. **典型的自由场地：**一般使用没有互联单元的三通道内置传感器仪器，每个通道有一票且仅需 1 票触发，则任何通道都可以触发系统进行记录。

Interconnected System: For example: two K2s with internal EpiSensors in a building; one in the basement and one on the roof. The K2s are interconnected. Initially we set 1 vote for each channel and the external trigger and 1 vote to trigger. We find that the K2 on the roof often triggers the system due to the building swaying in the wind. We can compensate for this by changing the voting of the roof unit so that its three accelerometer channels have 1 vote while the external trigger has 3 votes. We set the trigger weight to 3 in this unit. Now all of the channels on the roof must trigger simultaneously to record or the unit must be forced to record by the unit in the basement triggering. **互联**

系统：例如，两个具有内部传感器的记录仪位于同一建筑物中，一个在底层，一个在房顶，记录仪相互联接。开始，每个通道及外部触发各分配 1 票，并且 1 票触发，我们发现由于建筑物在风中摇动，房顶的记录仪经常触发系统，我们可以通过改变房顶仪器的票数来补偿这个现象，将顶层记录仪的三个加速度通道各 1 票，外部触发设为 3 票。我们将仪器的触发加权设置为 3，房顶所有通道必须同时触发才能产生记录，或者由底层仪器触发而强迫上面仪器记录。

System on a Bridge: With a 12-channel K2 on a bridge with 12 sensors connected we could start with all channels having 1 vote and requiring 1 vote to trigger. We may find that this system triggers far too often from traffic vibration or swaying of the bridge. We could then require several sensors to trigger by setting the votes to trigger to 2 or 3 and could even give those aligned with the direction of sway 0 votes. In extreme cases we can give the channels aligned with the direction of sway negative votes, so that several other channels must trigger to overcome their negative votes.

In conclusion, from these examples we can see the flexibility of the triggering options and some of the ways this flexibility can be used in particular installations.

设在桥上的系统：用一台 12 通道 K2 记录器在桥上与 12 个传感器连接，我们可着手规定所有通道有 1 票并需要 1 票触发。我们能发现系统由于交通振动或桥梁摇晃而太频繁地触发。於是我们可要求几个受交通振动或桥梁摇晃影响小的传感器调整其触发票权到 2 或 3 并且可给予顺桥梁摇晃方向的通道的触发票权为 0。在极端的场合我们甚至可给予顺桥梁摇晃方向的通道的触发票权为负值，以使它们只有在克服了负票权后才能触发。

最后，从这些例子我们能看到触发选择的灵活性和将其用于特定安装中的一些办法。

Data Storage Configuration 数据存储设置

The location of the files and the directory structure of the instrument now need to be configured as described below. 文件的存储位置以及仪器的路径结构按以下步骤设置。

PRIMARY & SECONDARY STORAGE 主要的和第二位的存储

The K2 stores data on PCMCIA ATA flash drives or, optionally, on PCMCIA hard drives. If you have installed two drives in the system, select which is to be the primary and which the secondary drive in the *Stream* parameter window. Note that the Makalu should not be used with a PCMCIA hard drive. 仪器在 PCMCIA ATA 闪烁存储器中或 PCMCIA 硬盘中存储数据。如果你在系统中安装了上述两种驱动器，在数据流参数窗口中设置其中一个为主驱动器，另一个为从驱动器。

Note: The K2 tries to save all event files in the primary storage drive. If this drive is full or missing the data is saved to the secondary drive (if

present). If both drives are full, or the only drive in the system is full, data is lost and the previously recorded data is preserved.

注意：记录仪首先向主存储器存放数据，如果主存储器已满，数据将存放在从驱动器中。如果两个驱动器已满，或仪器只安装一个驱动器而且数据存满，后面的数据将全丢失，而只保留以前的数据。

TREE OR FLAT FILE SYSTEM 树形或平面文件体系

The other data storage issue to decide is whether the data is to be saved in a tree or a flat file system. In the default tree data storage, each day's events are stored into a subdirectory named "\YYMMDD" in the EVT directory. In other words, all the data recorded on July 4th, 2001 are in the directory "EVT\010704". In a flat file system, all the data are saved into the EVT subdirectory and no lower-level subdirectories are created. 数据存储的另一个问题是：数据是否以树形目录存储或以平面形目录结构存储，每天的事件存储在 EVT 目录下的名为“\年月日”的子目录下。例如，在树形结构文件系统中，所有在 2001 年 7 月 4 日的记录数据存储在 EVT\010704 目录中。而在平面文件系统中，所有文件存储在 EVT 目录下，不再建立低一级的子目录。

Use the **AQ FILE** command in the Terminal window to select the file system type. **AQ FILE 0** sets the default tree structure, while **AQ FILE 1** selects the flat file system. 在终端窗口中使用 **AQ FILE** 命令选择文件系统类型。**AQ FILE 0** 缺省设置表示树形目录，命令 **AQ FILE 1** 为选择平面文件系统。

Generally, the tree structure is useful if you wish to quickly find an event on a certain day, or if you automatically retrieve data on a daily basis. The flat file structure is useful if you retrieve data at irregular intervals or if you use an automatic retrieval system. 一般，如果你想迅速地找到在特定的某一天的事件或者你想每天自动回放数据，树形结构是非常好用的。如果你以不规则的间隔回放数据，或使用自动数据回放系统，平面结构则比较方便。

PREPARING NEW PCMCIA CARDS 准备新的 PCMCIA 卡

Normally, all new PCMCIA cards received from Kinometrics have been preformatted. All PCMCIA cards should be formatted as described below. 你从 Kinometrics 公司得到的新的 PCMCIA 卡已经被预先格式化了。所有的 PCMCIA 卡将以以下描述的方式格式化。

Place the new media in an available PCMCIA slot and use the Terminal window **Format** command. Then try to read the device in the PC you plan to use with the recorder to make sure that computer can read the card. If your PC cannot read the card, get the latest release of the PCMCIA drivers and try these. Kinometrics web site contains links to help you find the latest drivers. 将新的 PCMCIA 卡插入有效的 PCMCIA 插槽中，使用终端窗口 **Format** 命

令。接着，试着从你计划与记录仪相连的微机中读 PCMCIA 卡，以确定计算机是否可读该卡。如果你的计算机不能读该卡，安装 PCMCIA 的最新驱动程序再试着读。Kinometrics 的网站有帮助你找到最新驱动程序的联接。

As a final option, it is possible to format the card in your laptop and see if the recorder can write to it. The potential problem with this option is that the format may not be optimal, and the cards — particularly hard drives — might not be able to keep up when recording 12 channels at 250 samples per second. 作为最后一个选项，从你的笔记本电脑中格式化卡是可能的，并且看一下记录仪是否能写卡。该选项潜在的问题是格式可能是不合适的，卡——特别是用 PCMCIA 硬盘驱动器当记录介质时，可能会不支持。

Caution: Possible data loss. If you format the cards in your laptop, are running 6 or more channels, and/or the streaming data protocol, the card may not keep up with the data rate and data could be lost. Configuring Communication Options

告诫：可能的数据丢失。 如果你在你的笔记本电脑上格式化 PCMCIA 卡，并且运行 6 或更多通道和/或数据流协议，记录卡可能因不再保持原数据率而致使数据丢失。见通信选项设置

The recorder is designed to send and receive communications in a variety of ways. This section explains how to configure the parameters correctly so you can use these options. 记录仪能够以多种方式发送和接收通讯信息。本节阐述怎样正确设置通讯参数以保证通讯选项的正常使用。

The recorder can be connected to the PC directly from the RS-232 port via an RS-232 cable. The maximum length of an RS-232 connection is 50 feet. 记录仪可以使用 RS-232 接口，通过 RS-232 电缆直接与个人微机相连。连接线的最大长度为 15.24 米。

The recorder can also be connected to the PC via two modems — an internal PCMCIA or an external modem at the recorder, and an internal or external modem at the PC using a public telephone carrier. Other devices such as Frame Relay Access Devices (FRAD), an ISDN modem or a spread spectrum modem can be used to implement the physical link between the recorder and the remote PC. 本记录仪也可通过 2 个 modem，即一个内部的 PCMCIA 卡接口的 modem 和一个外部的 modem 与 PC 机相连。其它设备像依赖于帧转换插页存取设备 (FRAD)、ISDN modem 或宽带 modem 也可用于远程 PC 机和记录仪的连接。

The physical connection between the recorder and the PC is invisible within QuickTalk, except that the user must first establish a modem connection between the recorder and the PC. PC 机与记录仪的物理连接状态，通过 QuickTalk 软件是看不到的。第一次用 modem 和 P C 机建立连接的用户除外。

RS232 DIRECT CONNECTION RS-232 直接连接

To communicate directly to the recorder using an RS232 cable, the only configuration required is to match the baud rate of the instrument to the COM port of the PC. This procedure is explained in the *Quick Talk Quick Look Users Guide*. 使用 RS-232 接口电缆直接通讯，仅需记录仪与 PC 机的 Com 口的波特率相匹配。连接过程请参考 *QuickTalk* 和 *QuickLook* 通讯软件用户手册。

Modem and Other Remote Connections 和其他远程连接

The recorder can be configured in several different telecommunication modes depending on your requirements. 记录仪可以根据你的需要设置成几种不同的通讯模式。

Answer Mode 应答模式

System will answer a call on either the PCMCIA modem or its external modem. This is the simplest telecommunications mode. 记录仪可以通过内部 PCMCIA modem 或它的外部 modem 应答呼叫。这是最简单的通讯模式。

Auto Call Mode 自动呼叫模式

The unit will call you if a certain event occurs and will also answer if you call the unit. 当一个特定的事件发生时记录仪将呼叫你，反之如果你呼叫记录仪，记录仪将应答。

Cellular Power Control Option 蜂窝移动电话控制选项

This option will provide power to external telecommunications devices such as cellular phones at the appropriate time. 这个选项是针对现代通讯而设计，为外部通讯设备提供供电控制的选项，例如蜂窝移动电话的电源控制。

Your decision on how to use the recorder will determine which remote communications option you use. As an example, if you wish to perform only remote maintenance on the unit, the answer mode would be sufficient. However, if you wish to be notified rapidly after a seismic event, the auto call mode is required. In the following sections the configurations of each of these options is described. 你希望怎样使用记录仪将决定你选用那一种远程通讯选项。例如：如果你仅仅是需要远程维护，那么应答模式是最有效的。如果你想迅速知道一个地震的发生，自动呼叫模式是必需的。以下将分别阐述对每一种选项的设置。

ANSWER MODE: PHONING IN TO THE RECORDER

应答方式:打电话到记录器

In Answer Mode the recorder allows the recorder modem to answer incoming calls. This is the default mode the system enters after power-up, as long as the Autocall/Answer parameter has not been turned off. A supported PCMCIA modem must be inserted in Slot B of the recorder's PCMCIA board or an external modem must be connected to the RS232 port. 在应答模式下，记录

仪允许它的 modem 应答进来的呼叫。这是开机以后系统的缺省模式。在自动呼叫/应答参数没有被关闭以前，一直保持这种状态。一个支持 PCMCIA 的 modem 必须被插入到记录仪的另一个 PCMCIA 卡插槽中，如果使用外部 modem，则必须连接到记录仪的 RS-232 接口上。

In Answer Mode, the system sends a modem initialization string to the modem at regular intervals. This string must enable the modem's Auto Answer Mode; for a Hayes compatible modem, this command is ATSO = 1. This initialization string is sent on a regular basis to ensure that the modem is always ready to receive your call and has not "forgotten" its settings. 在应答模式，系统以规定的时间间隔向 modem 发送 modem 初始化数据串，该数据串必须使 modem 的自动应答模式处于“开”状态。对于兼容的 modem，这个命令是 ATSO=1。以一定规律发送出去的初始化数据串，可以保持 modem 时刻准备着接收你的呼叫，并且不会“忘记”它的设置。

AUTOCALL MODE: USING THE RECORDER TO PHONE YOU

自动方式：由记录器给你通话

In Autocall Mode the recorder allows its modem to answer an incoming call, but it can also initiate a call if certain call-out criteria are met. To use this feature, check **Enable Auto-Call Mode** in the *Modem Parameters* dialog box in the *QuickTalk Parameter Editor*. You can configure the recorder modem to dial out in case of the following: 在自动呼叫模式下，记录仪也允许它的 modem 应答进来的呼叫。但是如果特定的呼起条件满足时，记录仪则能初始化一个呼叫，为了使用这个特性，请在 *QuickTalk 参数编辑器* 中打开 modem 参数对话框，检查自动呼叫模式（**Auto-call-mode**）应该设置为可用（**Enable Auto-Call Mode**），使其处于打开状态。你可以设置 Etna 记录仪的 modem，使其在以下情况下呼叫：

- A new event is detected 检测到一个新的事件
- Battery voltage falls below 12 volts 电池电压低于 12 伏
- There is a loss of DC power input 没有直流电源输入
- The global positioning system (GPS) fails to lock within the specified time limit 全球定位系统不能在特定的时间内锁定
- The temperature falls below -20 degrees C or rises above 60 degrees C 温度低于零下 20 或高于 60

To select these Autocall options just put a check in the dialog box. 选择这些自动选项仅需在对话框中的选项处打一个记号。

For the recorder modem to dial out, you must provide an initialization string, a primary phone number and, if desired, a secondary phone number. Enter the number of redial attempts and the setup string for the modem. Finally, specify the message that the recorder should send when it connects. 为了能使记录器的 modem 能够向外拨号，你需要提供一个初始化的信息串、一个基本的电话号码（主叫电话），如果你愿意，也可提供第二个电话号码

(次叫电话)。键入重拨次数，并且设置 modem 的信息串，最后指定当记录仪接通时，它应该送出信息。

Use the *Modem Parameters* dialog box in the *QuickTalk Parameter Editor* to change recorder modem parameters, or use the *Modem Auto* command in the Terminal window. 使用 *QuickTalk 参数编辑器* 中的对话框，在 *Modem Parameters* 对话框中改变记录仪的 modem 参数，或者在终端窗口使用 *Modem Auto* 命令。

You can enter Autocall Mode from the Terminal window with the *Callmode* command. 你在终端窗口输入 Autocall mode(呼叫模式)命令，即可进入自动呼叫模式。

If you set the parameters to enable Autocall Mode, the recorder enters Autocall Mode automatically after five minutes in Monitor Mode, or after fifteen minutes in Block Mode. Kinometrics designed the above precaution to make sure the system will return to the correct operating mode after a field service visit. 如果你设置参数使自动呼叫处于打开状态，在监控模式下 5 分钟以后，记录仪自动进入自动呼叫模式，或者 15 分钟以后进入程序块模式 (Block Mode)。Kinometrics 设计了以上预警，以确保系统在现场运行中当被访问之后能返回到正确的操作模式。

Note: Refer to the *Using QuickTalk & QuickLook Software User's Guide* for more information about recorder and PC modem settings.

注意：请参考“*QuickTalk 和 QuickLook*”软件用户手册以获得更多的有关记录仪和 PC modem 设置的信息。

CELLULAR PHONE CONTROL 便携蜂窝电话控制

The recorder has an external hardware line that can be programmed to provide a signal to turn power on to external equipment such as a cellular phone, when the recorder needs to make a call, or at certain times of the day to allow you to call the equipment. To use this feature you must provide a relay to turn the power to the equipment on and off. The recorder includes a CMOS-compatible active-high output to control the relay. This feature saves power and preserves the instrument's power autonomy when the communications equipment is powered from the same battery or solar charging system as the recorder. 当记录仪需要呼叫或在某一天的特定时间，你可以呼叫设备时，记录仪外部设备硬件线路，可以通过编程提供一个信号打开外部设备（例如蜂窝移动电话）。为了使用这个特性，你必须提供一个继电器打开电源使设备处于开或关状态。记录仪包括一个“打开—快速动作—低输出”的控制继电器。当通讯设备是由记录仪的电池或太阳能充电系统提供电源时，这种特性可以维护设备的自主电源并节约电能。

These parameters must be set to use cellular power control: 这些参数必须使用移动电话的电源控制来设置：

Cellular Warm Up: The time in seconds that the system will wait after asserting the power on signal before attempting to establish the connection.

This time should be set long enough for the telecommunications equipment to power up and be ready to make the connection.

移动电话预热：在准备建立连接之前，系统在确认电源信号之后应该有一段等待时间。这段时间应该设计得足够的长，以确保通讯设备加电，并且为连接作好准备。

Cellular Duration: This is the time in minutes that the power will remain on at each time you have set to call in to the instrument. If set to 0 the power will never be enabled. If set to -1 the power control line will always be on.

移动电话持续时间：在你呼叫设备时电源持续时间。如果设置为 0，电源将处于“关”状态，如果设置为 1，电源控制线处于“开”状态。

Cellular On Call-In Times: These are up to 5 times listed in 24-hour format (HH:MM) during which the recorder will turn on power to the equipment. The power will remain on for the time given in the Cellular Duration. Setting the hour to -1 disables that particular call-in window.

移动电话呼叫时间：最多有 5 个时间以 24 小时格式列出（格式为“时：分”），在所列的 5 个时间，记录仪将打开设备的电源，电源所持续的时间由以上电源持续时间设定。将时间设置为-1，将使呼叫窗口失效。

Cellular Power Control: This controls whether the cellular phone control is active on the front panel connection.

移动电话功率控制：管理移动电话控制在前面板连接上是否动作。

These features can only be set in Terminal mode. Put the instrument into Edit mode by typing **Edit** at the * prompt. Then set each parameter as described in the *Using the Terminal Mode* section of the *QuickTalk & QuickLook User's Guide*. 这些特征仅能在终端模式被设置。通过在*提示符处键入 Edit 使设备进入编辑模式。然后根据 *QuickTalk 和 QuickLook 通讯软件用户手册*中“使用终端模式”一节所述进行参数设置。

CELLULAR DURATIONS *minutes* 电话持续时间 (CEL DUR 分钟)

Length of time the call-in window is enabled. Enter 1-127 to specify the number of minutes the window is enabled starting at the time specified by the Cellular On command. Enter 0 (the default) to disable the call-in window. Enter -1 to leave the call-in window on at all times. 呼叫窗口打开的持续时间，键入 1—127 中的某个数，以规定在被 Cellular On 命令规定的时刻窗口打开的时间（分钟）。键入 0（缺省），关闭电话呼入窗口；键入-1，可以在任意时刻离开呼入窗口。

CELLULAR ON *window_number hour minutes* 移动电话打开窗口 (CEL ON 号数 小时 分钟)

Start times for the five available call-in windows. The window number is 1-5. The hour setting is 0-23; enter -1 to turn the window off. The minute setting is

0-59. Enter **CEL ON** with no arguments to display all cellular times. 5 个活动呼叫窗口开始时间，窗口数号是 1—5，小时设置为 0~23，分钟的设置为 0~59，键入 -1 关闭窗口。键入 **CLE ON** 显示所有的移动电话时间。

CELLULAR POWER_CONTROL 移动电话功率__控制

Toggles control of the front panel auxiliary I/O connector 1PPS line. Disabled: 1PPS out. Enabled: cellular phone control out. 前面板辅助 I/O 连接器 1 PPS 线的反复回路控制。Disabled 使无能：1PPS 输出；Enabled 使能：移动电话控制输出。

CELLULAR WARMUP *seconds* 移动电话“预热” (CEL WAR 秒)

Time between when the cellular phone is enabled and when it calls out; this enables the cellular phone to warm up. Possible entries are 0 (the default) to 255. 移动电话准备好到开始呼叫之间的时间，这可以使移动电话有预热准备。有效的设置是 0 (缺省) 到 255。

Note: On windows may overlap and/or cross midnight.

注意：在窗口上可以重叠并且/或者交叉夜间 0 点时间。

Here is an example of how to use these features: You have a recorder in a remote area equipped with a cellular phone. You would like to contact the unit every day at 8 P.M. for 10 minutes or, if you miss this time, at 10 P.M. for 10 minutes. You would also like the unit to call you if it detects an event or loses power. You have tested the cellular phone and found it is ready to make a call 5 seconds after power is applied. You need to set the Cellular Warm Up to 5 seconds, the Cellular Duration to 10 minutes and enable to **CELLULAR ON** times at 20:00 and 22:00. You will also need to enable the AutoCall mode. You would issue the following commands in the EDIT window: 这里有一个如何使用这些特性的例子。假设你在远处有一台装备了移动电话的记录仪，并且希望在每天的下午 8 点与记录仪联接 10 分钟。如果错过了这个时间，在下午 10 点联接 10 分钟，你希望仪器在检测到地震事件或没有电源的情况下向你呼叫。你已经检查了移动电话并且发现它已准备在电源送上后 5 秒钟呼叫。为了完成上述功能，设置预热为 5 秒；设置移动电话持续时间为 10 分钟；并打开“移动电话打开窗口”，设置 20:00 和 22:00 及打开自动呼叫模式；在编辑窗口输入命令如下：

CEL DUR 10

CEL ON 1 20 00

CEL ON 2 22 00

CEL WAR 5

Digital Field Station 数字现场台站

The digital field station provides one of two possible real-time data streams for receiving data from the instrument in real time. In the **CRLF** format, the data is taken directly from the DSP after filtering and decimation to 100 samples per second and is sent as a simplex RS232 data stream to the front panel connectors. This protocol can be used to implement a real-time digital system using the IASPEI software suite. Contact Kinemetrics for more information on setting up an IASPEI central recording station. Please note that the data stream is *not* time-tagged, is a one-way link, and truncates the data to 16 bits. These compromises allow the use of low-cost, one-way radio systems. 数字台站简称 DFS,提供两个实时数据流之一用以自仪器实时接收数据。在 CRLF 格式下,数据通过滤波后直接从 DSP 中取出,转化为 100 点/秒采样的数据流,传送到仪器的前面板上的单向 RS-232 接口上。通过使用 IASPEI 软件包,本协议可作为实时数字系统使用。与 Kinemetrics 公司联系可以获得更多的关于建立 IASPEI 台站中心记录的信息。请注意数据流是没有时间标记的,且是单路连接,数据被截短为 16 位,这种折衷办法是想充分利用低成本的单路无线电传输系统。

HARDWARE CONNECTION TO DIGITAL FIELD STATION

数字现场台站的硬件连接

The front panel connection for the RS-232 three-wire external connection for the digital field station is on the auxiliary I/O connector J4. Use the mating connector supplied in the accessory kit to connect this option. 用于 RS-232 三芯导线外部接口的前面板连接是在辅助 I/O 连接器 J4 上。使用匹配连接器支持连接该选项的成套附件。

Pin(接口针序) Definition (定义)

A	DSPRXD	RS232 input, not used (输入), 不能使用
L	DSPTXD	RS232 output (输出)
N, P, R, T, U	GND	(地)

OVERVIEW OF DIGITAL FIELD STATION PROTOCOLS

数字现场台站协议综述

There are two protocols provided: CRLF and KMI. 提供两种协议: CRLF 和 KMI。

CRLF This protocol transmits 1, 2 or 3 channels at 100 sps. The data format consists of a string of 16-bit data, one for each selected channel, delimited by a carriage return and a line feed. 本协议以 100sps 的速率传送 1, 2 或 3 通道的数据。数据构成包括一个 16 位数据串, 一个选择通道, 由数据回返和线路馈电方式来决定。

<LF><ch1-high><ch1-low><ch2-high><ch2-low><ch3-high><ch3-low><CR>

When the instrument sample rate is 200, the DFS data stream is filtered and decimated to 100 sps before output. The DFS cannot be selected when the instrument is recording at 250 sps. Note that the data is truncated to the high two bytes of the 24-bit data words. The 4800-baud rate will only support one channel and the CRLF protocol is limited to any three channels. 当设备的采样率为 200，DFS 数据流经过滤波和 10 进制转化以 100sps 的速率输出；当设备以 250sps 的速率记录数据时，则不能使用 DFS 功能。注意，这是因为数据已经被截断成 24 位数据字的高 2 个字节。由于 4800 波特的通讯速率仅能支持一个通道，于是 CRLF 协议限制了三个通道的同时传输。

Note: The KMI protocol is a project specific packet format. It is not for general use.

注意：KMI 协议是为一个特定项目定义的打包格式，一般用户不用。

CONFIGURING THE DIGITAL FIELD STATION 数字现场台站设置

The parameters that control the digital field station can be set using the QuickTalk parameter editor as described in the *QuickTalk & QuickLook User's Guide*. 控制数字台站的参数可以通过 QuickTalk 软件参数编辑功能设定。详见 *QuickTalk 和 QuickLook 通讯软件用户手册*。

Serial Data Streams 串行数据流

The second real time data stream available from the recorder is the serial data stream (SDS). The SDS provides a continuous flow of data samples from the recorder using block mode packets coming out the front-panel RS232 serial-port connector. This allows the recorder to be used as part of a real-time seismic monitoring system, while still retaining its ability to record large events on its local memory card. 从记录仪中获得的第二个实时数据流是串行数据流（SDS），SDS 是从前面板 RS-232 串口发出的块模式的数据包。SDS 提供了采样数据的连续性。这是为了让记录仪具有作为实时地震监控系统的一部分来使用而设计的，并且同时又具有在它内存卡中记录大地震事件的能力。

Note: The SDS is only available in application Firmware revisions from 2.07 onwards. Starting with recorder header versions 1.40, the Serial Data Stream parameters are stored in the event header. Beginning with QuickTalk version 2.09 and application code version 2.25 they can be changed in QuickTalk and by downloading a .PAR file.

注意：SDS 仅在应用固件为 2.07 版以后是有效的。启动记录仪 1.40 版的头文件，串行数据流参数存储在事件的头文件中。启动 QuickTalk2.09 版和应用程序 2.25 版，它们可以在 QuickTalk 中改动，并且下载一个.PAR 文件。

DESCRIPTION OF THE SERIAL DATA STREAM PROTOCOL

串行数据流协议描述

The description of the SDS and packet protocol in this section is brief and is intended as an introduction. If you wish to use the SDS we recommend that you obtain the *Altus Block Mode Communications Manual* from Kinemetrics. This will help you with examples of how to use the SDS and contains a description and format for the various packet types. 对于 SDS 和打包协议的描述在本节是简略的，仅仅作一般介绍。如果你想使用 SDS，我们建议你从 Kinemetrics 公司索取“*Altus 块模式通讯*”，这将帮助你获得一个怎样使用 SDS 例子，包括对不同打包类型和格式的描述。

The SDS consists of a series of blocks, each containing a data header and the specified number of samples for a selected channel. Each block of data is wrapped inside a serial data packet, which includes the SDS data header, and a trailer used for error correction. SDS 包括一系列的块，每个块都包含一个数据头（首部）和所选择通道定义的采样数。每一个块中包含了一个串行数据包，这里面包含 SDS 的数据头段信息的描述字符和用于错误修正的数据尾部描述字符。

Each block has a unique data sequence number allowing it to be identified and to allow the host to request retransmission of packets with errors. Each block also contains a time tag relating the data to UTC time. The instrument can create up to six streams, with each stream containing one channel of data. Currently the instrument must be recording at, and the streams must be sent at, 100 samples per second. 每一个块，仅有一个数据系列号。这可以使它能被识别并且允许主叫方要求重新传送该数据包以纠正错误。每一个块都包含一个与数据相关的 UTC 时间标记。设备可以建立 6 个数据流，每一个数据流是一个通道的数据，但这时数据的记录和发送仅对每秒 100 点的采样率有效。

The instrument has a serial data stream command buffer to process commands on a first-in first-out basis. It also has two separate block buffers, one for normal block flow and one for resend-retry requests. 设备有一个串行数据流命令缓冲区，在“先进-先出”的原则下执行命令。仪器还有两个分离的块缓冲区，其中一个用于一般的块流动，另外一个用作重新发送请求。

The instrument buffers a number of data blocks in a temporary file, #SSTRBUF.BIN. The maximum size of the temporary file is specified by the parameter BUFFER_SIZE. While a block is still in the buffer, it can be resent if requested by the host. Three communication modes are currently supported as discussed below: 仪器将数据块使用码进行标记后，存于一个临时文件中，文件名为 #SSTRBUF.BIN，缓冲文件的最大容量由参数 BUFFER_SIZE 确定。当一个数据块位于缓冲区中，它可以在主机的要求下重新发送出去。仪器支持以下三种通讯模式：

MODE 1 模式 1

Mode 1 is intended for one-way transmissions from the instrument to a host computer with software to decode and display the samples. Transmissions start automatically after reset. Mode 1 also supports full-duplex channels. The instrument will respond to control packets from the host to start/stop the stream packets and request retransmission of specific packets. 模式 1 是从仪器到主计算机（以下简称主机）的单路传送，用相应的软件解码并显示采样率。传送过程在重新设置后自动开始。模式 1 支持全双工通道。仪器对主机发出的控制数据包作业响应，以启动或停止流数据包和是否要求重新传送指定的数据包而实现控制。

MODE 2 模式 2

Mode 2 requires that the host send a continuation packet and, every “N packets.” The timeout is intended to shut off transmission after a fixed time. This limits the wasted bandwidth if the host goes down. If the host detects an error in a received packet, it may request a retransmission of that packet. 模式 2 要求主机每隔几个数据包发送一个顺序数据包。暂停时间超过确定的时间后将关闭传送。这样可以在主机停机的情况下减少带宽的浪费。如果主机在接收的数据包中发现错误，它可以要求重新传送那个数据包。

MODE 3 模式 3

Mode 3 is a full handshaking mode with packet flow controlled by the host. The host may queue up to 256 requests in the instrument, thus maintaining the data stream from the instrument where no channel errors or host buffer overflow occurs. If the host detects an error in a received packet, it may request a re-transmission of that packet. 模式 3 是一个全握手模式，并且由主机控制数据包的流动。主机可以在设备中排列 256 个请求，包括仪器的数据流，要求没有通道错误或主机缓冲区溢出发生。如果主机在接收的数据包中检测到错误，它可以要求重新发送那个数据包。

CONFIGURING THE SERIAL DATA STREAM 串行数据流设置

The parameters that control the serial data stream can be set using the QuickTalk parameter editor as described in the *QuickTalk & QuickLook User's Guide*. 控制串行数据流的参数可以使用 QuickTalk 软件 的参数编辑器来设置，详见 *QuickTalk 和 QuickLook 通讯软件*。

The buffer size should be large enough to buffer the blocks when other RS-232 traffic is using the RS-232 port, but not so large that nothing is left for recording event files. 缓冲区尺寸应足够大以保证其它的 RS-232 通讯缓冲数据块能够使用 RS-232 接口。但也不能太大以至于没有空间暂时存储事件文件。

The recorder's default buffer is 1Mb (64 16k blocks). However, in order to minimize wear, we recommend making the buffer as large as possible, e.g., for an 80Mb flash card, set the buffer to 40Mb. 记录仪的缺省缓冲区是 1Mb

($64 \times 16K$ 的块)，但是为了尽量减少损耗，我们建议缓冲区设置尽可能大一些，即对于一个 80Mb 的 flash 卡，将其缓冲区设置为 40Mb。

The transmission baud rate should be set so that transmission will only fall behind for short periods of time and not exceed the amount of data stored in the buffer. 设置传送的波特率时应该使传送稍滞后一段时间，而又不能使存储在缓冲区的待传输数据超量。

In order for the current version of the SDS to work, the SDS sample rate and the instrument's sampling rate must both be set to 100 samples per second. Future software releases are planned to support SDS at 20, 40, 50, 100 and 200 samples per second from up to 6 channels. 为了使当前版本的 SDS 正常工作，SDS 的采样率和仪器的采样率，都应设置成 100 点/秒。将来软件释放计划从多到 6 通道在 20, 40, 50, 100 和 200 sps 支持 SDS。

TCP/IP Support TCP/IP 支持

TCP/IP support for the Makalu or K2 may be purchased as an option if the recorder is using the latest MCU. Event-driven TCP/IP file transmission allows the recorder to dial an ISP using a PPP connection, then FTP the EVT files to a destination FTP site. 如果记录器使用最新的 MCU，用于 Makalu 或 K2 记录仪的 TCP/IP 协议支持将作为一个选件另行购买。获得记录事件后，TCP/IP 文件传送功能则允许记录仪拨号 ISP，使用 PPP 联接，将 EVT 文件以 FTP 的形式上传到目标 FTP 网站。

TCP/IP streaming is supported through use of an external terminal server connected to the front panel serial port, or via an optional internal Network Adapter daughter board. The Network Adapter daughter board is only available for recorders using the latest MCU. 本仪器通过使用外接终端服务器连接到仪器前面板的 RS-232 串行口或经由内部网络适配器辅板支持 TCP/IP 数据流。网络适配器辅板仅对采用最新 MCU 的记录器是可行的。

Sensor Settings 传感器安装

Internal EpiSensor decks on the K2 have their calibration data stored in a serial EEPROM on the EpiSensor oscillator board. This data is programmed at the factory and cannot be changed. K2 的内部 EpiSensor 传感器装置校准数据存储在串行 EEPROM 中（位于 EpiSensor 的振荡器板上），这个数据在出厂前已设置好，不能改动。

The K2 reads this information when the **DEFAULT FACTORY<CR>** command is issued at the **EDIT** prompt. If any of this information needs to be changed it can be done in terminal mode or by using the **Sensor** option under the **Utility** menu in QuickTalk. 在 **EDIT**（编辑）提示符下发出 **DEFAULT FACTORY**（回车）命令后，K2 读取传感器信息。如果该信息参数需要改动，可以在监控模式下或通过 QuickTalk 软件的 **Utility** 菜单下的 **Sensor**（传感器）选项来完成。

Note that if the **DEFAULT FACTORY<CR>** command is used after manually changing the sensor parameters, they will be overwritten by the parameters stored in the EpiSensor deck. To leave the sensor parameters unmodified, use the **DEFAULT<CR>** command instead. 注意：如果用手工改变传感器参数之后，使用“**DEFAULT FACTORY 回车**”命令，则传感器参数将被存储在 EpiSensor（传感器）装置上的出厂参数所代替，为了使参数保持不变，使用“**DEFAULT 回车**”命令。

Security & Passwords 安全和密码口令

Whether or not the recorder should be password protected depends on the installation. 记录仪是否需要口令保护由安装人确定。

If the recorder is connected to a PC via a modem that is linked to the public telephone network, set a password on the recorder according to the instructions in the *QuickTalk & QuickLook Software User's Guide*. If the recorder is password protected, unauthorized users cannot change recorder settings or retrieve or delete recorder data even if they break in to the system through the modem. 如果记录仪是通过与公共电话网相联的 Modem 与 PC 机连接的，根据 *QuickTalk 和 QuickLook 用户手册* 中的指导，应为记录仪设置口令。如果记录仪被口令保护，未授权的用户即使他们通过 Modem 切入系统，也不能改变记录仪的设置或回放、删除记录仪数据文件

Caution: Make a note of the recorder password. If you forget the password, you will need to physically remove both PCMCIA cards from the recorder to remove password protection and reset the password to nothing. This means a site visit!

告诫：记下记录仪的密码口令，如果你忘记了口令，你将需通过硬件操作（从记录仪拔下 2 个 PCMCIA 卡来去除口令保护），并重新将口令设置为无。但这意味着你将需到观测点去完成。

If the recorder is connected to a PC with an RS-232 cable only, consider physically securing the recorder and the PC. Use the locking hasps on the top of the case to secure the contents of the unit. The RS-232 port is not secure unless the recorder is password-protected. 如果记录仪与 PC 机之间仅用 RS-232 电缆连接，需考虑对记录仪与 PC 机进行物理保护，在箱体上的顶部用“搭扣加锁”保护仪器。如果记录仪未加口令，RS-232 端口输出数据的传输方式是不安全的。

Checking the Recorder Setup 检查记录器的设置

Check the recorder installation by running a functional test or by using the keyboard trigger if the recorder uses sensors other than an EpiSensor.

You can also gently shake the unit to simulate an event and check that Autocall mode is functioning. 运行“功能测试”以检查记录器的安装情况，如果

记录仪用的传感器不同于 EpiSensor 传感器时用键盘触发来检查。你也可以轻微摇动记录仪来模拟一次事件，再检查自动呼叫模式功能是否正常。

Refer to Chapter 4, *Maintenance & Service*, for information about running remote and on-site systems checks. 关于进行现场系统检查的信息见第 4 章的维护与保养。

The full scale range of the internal EpiSensor and their voltage levels are set at the factory to the correct values specified at the time of purchase. If you wish to change the settings, refer to Chapter 6, *Advanced Installations*. 满刻度的内部 EpiSensor (传感器) 和它的电压值，出厂时已按订购时的规定设定，如果你想改变设置，参考第 6 章高级安装。

Performing a Functional Test 完成功能试验

The firmware in your instrument performs a dual polarity pulse test on EpiSensors as the standard functional test when correctly configured. 在设置好后仪器后，利用仪器内的固件程序对 EpiSensor 传感器进行双相脉冲标定，进行功能测试。

THE K2

The height of the pulse will depend on the full-scale setting of the instrument but will correspond to a g level of approximately 0.125g. The exact value will be 2.5V multiplied by the sensor module's calibration coil sensitivity value provided on the sensor's data sheet. 脉冲的最大值依赖于仪器满刻度的设置（近似于 0.125g）。精确值是 2.5V 乘以传感器系数，该系数是标定线圈的灵敏度值，此值由传感器的数据表提供。（见图 21）

Figure 21: EpiSensor functional test display

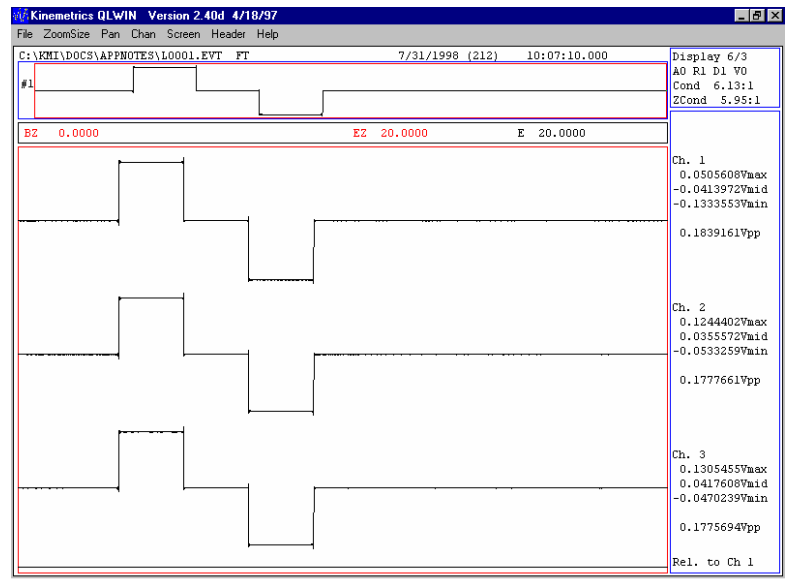
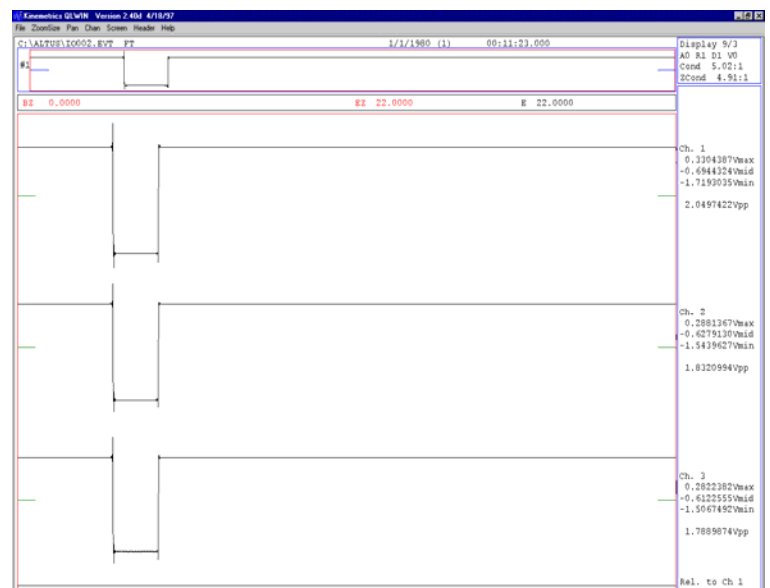


图 21 EpiSensor 功能试验的显示

Note: Altus software released prior to August 1998 supports functional tests on the earlier generation of Kinemetrics force balance accelerometers but does not support the EpiSensor. If you perform a functional test or sensor response test on an EpiSensor using older firmware, the record will appear as shown in the figure below.

注意：早于 1998 年 8 月发行的 Altus 软件支持以前的 Kinemetrics 公司生产的力平衡加速度计功能测试，但不支持 EpiSensor 传感



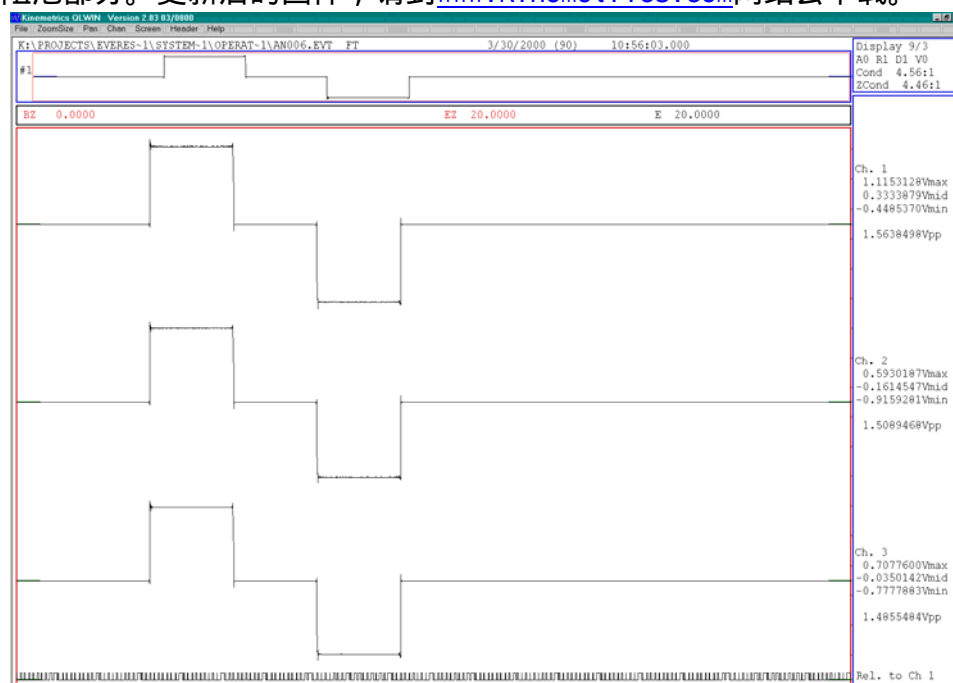
器，如果使用老的固件对 EpiSensor 传感器做功能试验或传感器反应试验，记录图如图 22。

Figure 22: EpiSensor functional test display using firmware released prior to August 1998

图 22 用固件在 1998 年 8 月前释放的 EpiSensor 功能试验的显示

The record looks like this because the calibration coil enable is only enabled during the undamped portion of the old FBA-11 style functional test.

To update your firmware, please go to www.Kinemetrics.com. 记录图之所以如此是因为标定线圈仅适用于老的 FBA-11 型加速度计的功能测试的无阻尼部分。更新后的固件，请到www.Kinemetrics.com网站去下载。



THE MAKALU

Makalu functional test records are similar in appearance to those of the K2, however, voltage levels are eight times greater but the equivalent acceleration levels will be the same. This is because the Makalu's full-scale range is 20 volts peak and the K2's is 2.5 volts peak. EpiSensors used with the Makalu should be set to produce the desired range in V/g. A 1g sensor should be configured for a sensitivity of 20V/g.

Figure 23: Makalu functional test record

图 23 Makalu 功能试验记录

Operating the Recorder 运行记录器

This section describes the basic operations you will be performing on your K2, such as retrieving data, managing the instrument's storage, performing functional tests, remotely calling the unit, and analyzing data from the unit. 这部分讲述 K2 的基本操作，像接收数据、管理仪器的存储、做功能试验、远程呼叫记录器和对数据的分析等。

Retrieving Data from the Recorder 从记录器回收数据

RS-232 DIRECT DATA RETRIEVAL RS-232 直接数据回收

Even if you normally plan to communicate with the K2 via a modem, you may sometimes need to visit the site and connect to the recorder directly with a laptop and an RS-232 cable. These instructions also appear in the *QuickTalk QuickLook User's Guide*. 虽然一般情况下你计划通过 Modem 和 K2 记录仪进行通讯，有时你必须到现场（观测站）将记录仪用 RS-232 线缆直接与笔记本电脑连接。这些指令也在 *QuickTalk* 和 *QuickLook 用户手册* 中出现。

Note: Make sure you have installed *QuickTalk* on the laptop PC you plan to use before arriving at the site.

注意：在到达现场（观测站点）之前，确认在笔记本电脑上已安装好 *QuickTalk* 软件。

The first time you run *QuickTalk*, the **Communications Setup** window appears. Select the initial COM port and baud rate in this window. Your selections will be saved when you exit *QuickTalk*, but you can change them as necessary by selecting **Comm Settings** from the *QuickTalk File* menu. 你第一次运行 *QuickTalk*，出现 Communications Setup 窗口，选择 COM 端口和波特率，在你退出 *QuickTalk* 时，你所作的选定会被保留下来，但是你也可以按需要从 *QuickTalk* 的“File(文件)”菜单中选择 Comm Settings 菜单改变设置

To do an RS-232 direct retrieval: 用 RS-232 线缆直接恢复数据

1. Disconnect any external modem cable from the K2 or any other communications equipment that might be connected to the RS-232 port. If the modem is internal to the K2, you do not need to disconnect it. 断开任何外置 Modem 线缆与 K2 或任何其它通讯设备与 RS-232 端口的连接。但如果 K2 所用的 Modem 是内置的不需断开内置 Modem。
2. Connect the K2 to the PC using an RS-232 cable. 用 RS-232 线缆将 Etna 与 PC 机连接好。

3. Double-click the **QuickTalk** icon or select it from the Windows **Start** menu. 双击 **QuickTalk** 图标或从窗口 (Windows) 的开始 (start) 菜单中运行 **QuickTalk** 软件。

4. After a few seconds, does the information display in the **Status** and **Directory** windows? 几秒钟后, 可在状态 (Status) 和目录 (Directory) 的显示中, 看到连接信息:

YES – You've established communications with the K2. Proceed to Step 8. 是 (YES) —你已和 K2 建立了通讯联系。

5. Open the **Communications Setup** window by selecting **File** and then **Comm Settings**. Verify that you have the correct COM port selected. Is the COM port correct? 选择文件 File(文件)和通讯设定 (Comm Settings), 打开通讯设置 (Communications Setup) 窗口, 确定, 选择正确的 COM 端口。COM 端口正确吗?

NO – Change it and close the Communications Setup window by selecting OK. Go to Step 4. NO (不) ——改变它, 选择 OK 按钮, 单击之, 再关闭通讯设置窗口, 转向第 4 步。

YES – The baud rate is probably incorrect. Follow Steps 6 and 7 below. YES (是) ——对, 但波特率可能不正确, 进行第 6 步和第 7 步。

6. Open the **Terminal Window** by selecting **Window** and **Terminal Window**. 选择窗口 (Window), 进入终端窗口 (Terminal Window), 打开终端窗口 (Terminal Window)。

7. Click on the **Terminal Window**.

Enter \\ (three backslashes followed by the **Enter** key) until the "*" prompt appears. You may have to enter \\ more than once.

Does the "*" prompt appear? 单击终端窗口 (Terminal Window), 键入三个反斜杠, 压回车, 直到 "*" 提示出现。你也许需要不止地键入 \\ (三个反斜杠)。观察 "*" 提示符出现了吗?

YES – You've established communications with the K2.

Proceed to Step 8. 是 (YES) —你与 K2 已经成功建立了与 PC 机的通讯。继续进行第 8 步。

NO – Open the **Communications Setup** window by selecting **File** and then **Comm Settings**. Change the baud rate and close the Communications Setup window by selecting OK. 不 (NO) —选择 **File** (文件) 和 **Comm Settings** (通讯设置), 打开通讯设置窗口。改变波特率, 选择 OK 按钮, 单击之。再关闭通讯设置窗口。

Repeat as necessary until the "*" prompt appears. 必要时, 反复上述步骤, 直到 "*" 提示符出现。

8. Close the Terminal window and begin your communication session with the K2. 关闭终端窗口, 开始与 K2 通讯。

Note: Remember to reconnect any equipment that you disconnected from the RS-232 port when you complete your work.

注意：记住，当你完成你的工作时，并从 RS-232 端口断开后，别忘了恢复原来连接在 RS232 口上的设备。

RETRIEVING DATA REMOTELY 远方回收数据

To remotely retrieve data you must establish a telecommunication link between the PC and the recorder. To do this the recorder must be equipped with a modem and be in answer mode. The *QuickTalk QuickLook User's Guide* contains detailed instructions on setting up this link. 若远程接收数据，你必须建立 PC 机与记录器之间远程通讯的连接，这样做记录器必须配备 Modem 而且处于应答模式。*QuickTalk* 和 *QuickLook 用户手册* 中包括建立连接的详细说明。

Downloading Data Automatically 数据自动下载

You can create a user program to automatically download recorder data and log maintenance problems. Contact Kinemetrics for specific information about implementing this feature. Kinemetrics' Network Management System program also performs this function. 建立一个用户自动下载记录器数据的程序并下载有关维护问题的记录。应该与 Kinemetrics 取得联系，即可获得实现此性能的特殊专门信息。Kinemetrics 网络管理系统程序可以实现此项功能。

Finding Files 发现文件

Filenames are standard DOS filenames. The recorder uses file extensions to describe the file contents. The extensions can be one of the following: 文件名用标准 DOS 文件名。记录器使用文件扩展名来标示该文件的内容，扩展名有以下几种：

- .par Communications parameter file created with the EDIT SAVE command, or in QuickTalk. .par—通讯参数文件，用 EDIT SAVE 命令或在 QuickTalk 下创建。
- .evt Event file created automatically when an event is detected and acquisition is on. .evt—事件文件，当事件被测出并记录时，自动创建的文件。

To display the file directory, use the QuickTalk directory window, or enter **DIR** in the Terminal window. 用 QuickTalk 目录窗口或在终端窗口键入 **DIR**，可以显示文件目录。

Each directory entry has a file status string. Table 4 describes the meaning of each status code. 每个目录项都有一个表示文件状态的字符串，表 3 说明了每个状态代码的含义。

表 3 文件状态代码

Table 3: File status codes

Status Code 状态代码	Meaning 意义
D	Deleted file 删除了的文件
R	Read-only files 只读文件
A	The file archive bit is set. The archive bit is set for new or modified files. (Archive bit is reset when you download the file.) 文件归档位标志，归档位提示该文件为新文件或修改后的文件。（归档位，在恢复文件后重新设定）。
S	System file 系统文件
H	Hidden file 隐藏式文件

When an event is detected, the recorder automatically records it to an .evt file. 当事件被监测后 Etna 自动记录到一个 .evt 文件。文件名是记录仪按下下述过程自动形成的。

- The recorder uses the restart counter (the number of times the application program was restarted) and the event number (which is always reset to zero when the application program is restarted) to create a unique filename. 记录器用重启计数器（这计数器是靠重新启动应用程序来完成的）的事件序号（这个序号在应用程序重启后重新设置为 0）来建立相互独立文件名。
- The event filename is in the form xxnnn.evt, where xx are the two alphabetic characters formed from the number of times the system was restarted. The nnn is the event number; 001 represents the first event since the system was restarted. 事件文件名格式为 xxnnn.evt，由于计数系统被重新启动，这里 xx 是按字母顺序排列的两个字母。这个 nnn 是事件号数，001 代表系统重新启动后第一个事件。
- Every time you reset or restart the recorder, the xx prefix is incremented and the event number is reset to 001. The event number can go up to 65535 before cycling back to 1. 每次重新设置或重新启动记录仪，文件名的前 2 位 xx 是递增的，并且紧跟其后的事件序号(nnn)重新设置为 001，事件数上升到 65535 后自动循环到 1。
- The xx ranges from AA to ZZ, which represents 676 restarts before cycling back to AA. It is therefore very unlikely to get two events with the same filename. 这个 xx 范围从 AA 到 ZZ，周期性返回到 AA 之间，计有 676 个状态。因此，两个事件文件名发生同名的可能性很小。

Retrieving Files 回收文件

To use QuickTalk to download event files from the recorder to your PC: 从记录器到你的计算机，用 QuickTalk 软件恢复事件文件的步骤：

1. From QuickTalk, go to the desired drive by clicking on **A:** or **B:** button in the Directory window. 从 QuickTalk 软件中选择想要的 A：或 B：，然后在目录窗口中点击 A：或 B：按钮。
2. Double click on the directory entry to change to that directory (double click on the ... entry to go up one level to the parent directory). 双击目录，进入变更目录（再双击目录又返回原来的目录）。
3. Double-click on the filename to download that file. After you download the files the recorder clears the archive bit in the file's directory entry. 双击文件名回收文件，你回收文件后，记录仪会清除文件目录列表中的归档位标志。
4. Use QuickLook for Windows or another communication program to view recorder event files. 用 QuickLook 的窗口或另外的通讯程序查看记录仪的事件文件。

To download files, use the **TX** command in the Terminal window. Once a file has been retrieved from the recorder to the PC, you should probably delete it from the recorder in order to free up disk space. Refer to the next section. 若在终端窗口回收文件可用 TX 命令。一旦一个文件从记录器回收到 PC 机上，为了释放磁盘上存储空间，你可以从记录仪删除它（参考下一部分）。

Managing Data Storage & Deleting Files

管理数据存储和文件删除

In order to free up disk space on the recorder, delete files once you have saved them to your PC. 为了释放记录器的磁盘空间，将已在你的 PC 上存储过的文件进行删除。

To delete a file from the recorder, select the file's name in the QuickTalk Directory window, then click on the **Delete** button. (Or, from the Terminal window, you can delete a file using the **DELETE** command.) These commands flag the file as deleted and return the memory space to the amount available. 从记录器删除一个文件，在 QuickTalk “目录” 中选择文件名，然后点击删除 (**Delete**) 按钮。标记过的文件将被删除，并释放内存空间。或者从终端窗口用 **DELETE** (删除) 命令，就可以删除一个文件。

The recorder has no internal command to undelete files. However, if your PC contains software designed to undelete files – and as long as the deleted file's memory space has not been re-used – you should be able to use your PC to restore that file. 记录器无内部命令用来恢复已删除的文件。但是如果你的 PC 机中包含有反删除设计软件，且已删除文件的存储空间尚未被使用，也许能够用你的 PC 机恢复已删除的文件。

Removing PCMCIA Cards 取出 PCMCIA 卡

If it's not possible to retrieve data from the recorder either on-site via the RS-232 port or remotely via a modem connection, you can physically remove the PCMCIA card or cards from the unit, replace them with additional formatted PCMCIA cards, and read the cards you removed on a PC. You may wish to do this after a strong earthquake when you need to rapidly retrieve data. Volunteers can be used to remove the cards and replace them with new cards. This process is simple and does not require a laptop computer. 如果不可能在现场从记录器的 RS-232 端口通道或在远程用 Modem 连接接收数据，你可以将 PCMCIA 卡从记录仪中取出，用附加的、已格式化好的 PCMCIA 卡替代原卡，把原卡插在 PC 机上读取数据文件。你希望在强烈地震以后需要迅速的接收数据，为此，主动地用新卡替代从记录仪中取出的卡，这个过程是简单的，并且不需笔记本电脑。

1. Remove the lid from the unit. 移去记录器上面的盖子。
2. Make sure the Busy LED on the front of the unit is not flashing (this means the unit is not writing data to the PCMCIA card). When the Busy LED is off, switch the *OPER/STBY* switch to the STBY position. 确定仪器前面板工作状态发光二极管不闪烁（不闪烁意味着仪器未向 PCMCIA 卡写数据）。当工作状态发光二极管不闪烁时，将 *OPER/STBY* 开关打在 STBY（暂停位置）。
3. Push the Eject button on the PCMCIA drive. The card will pop out of the drive. 按下 PCMCIA 卡上的弹出按钮，卡会从驱动器槽中弹出。
4. Label the card so you know which unit it was removed from. 标注该卡，以便知道它是从那台仪器取下的。
5. Insert a new, formatted PCMCIA card into the drive. (This card can contain a new autoload.par file to load onto the unit.) Push down firmly on the card until you hear a click; the Eject button should pop up. 插入一个新的格式化好的 PCMCIA 卡。（这卡中应装有一个新的自动装载文件（.Par），以便装入仪器上）。
6. Repeat Steps 3 through 5 for the second PCMCIA drive, if applicable. 如果需要，重复 3-5 步骤，安装“从 PCMCIA 驱动器”B。
7. Put the *OPER/STBY* switch back in the OPER position, and refasten the lid on top of the unit. 将开关（*OPER/STBY*）复位到开（*OPER*）的位置，重新固定该仪器的盖子。

Use QuickLook to view the event files on the PCMCIA cards you removed from the unit. 从该记录仪中移出的 PCMCIA 卡上，用 QuickLook 软件查看事件文件。

CONFIGURING THE INSTRUMENT USING AN AUTOLOAD.PAR FILE

用 AUTOLOAD.PAR 文件设置仪器

If a PCMCIA card is inserted into the unit with a valid parameter file called AUTOLOAD.PAR stored in its root directory, the recorder will load and use these parameters when its power is cycled. In this way you can reconfigure the unit in the field without using a laptop. 如果将含有正确参数称作 AUTOLOAD.PAR(自动装载文件)文件存在根目录下的 PCMCIA 卡插入 Etna 记录仪中，当记录仪周期性供电时，有用参数被自动装载。用这种方法，你可在现场没有可用的 laptop 计算机情况下，重新配置仪器。

Analyzing Recorder Data 分析记录器的数据

After downloading data from the recorder, you will want to view the data and analyze it. Kinematics provides QuickLook to let you visually examine the record and produce quick plots of the data. We also provide programs to convert the data to other formats so you can analyze it with your own favorite tools. Finally, Kinematics sells data analysis programs such as the *Strong Motion Analyst*. 从记录仪中下载数据以后，你需要查看波形或分析数据。Kinematics 提供的 QuickLook 软件让你能直观地看到记录数据和快速地制成图表。我们也提供将数据转换为其它格式的程序，以便你用自己喜欢的工具软件分析数据。最后，Kinematics 还出售数据分析程序，如“强运动分析（SMA）”。

QUICKTALK & QUICKLOOK QUICKTALK 和 QUICKLOOK 通讯软件

For instructions on how to use QuickLook to view event files retrieved from the recorder, refer to the *Using QuickTalk & QuickLook Software: User's Guide* in the back of this binder. 如何应用 QuickLook 查看从记录仪中回收回来的事件文件，请参考 *QuickTalk 和 QuickLook 通讯软件用户手册*。

GETTING DATA INTO OTHER PROGRAMS 取数据进入其它程序

Kinematics provides converter programs to translate recorder data into ASCII code. In addition, when in QuickLook you can use the right mouse button to copy a section of the QuickLook display to the Windows clipboard. From there, you can paste the display image into other Windows applications such as a Microsoft Word document. Kinematics 提供的转换程序是将记录仪的数据转为 ASCII 格式，另外在 QuickLook 窗口中，你可以用鼠标的右键按钮拷贝 QuickLook 显示部分到 Windows 剪贴板中，然后你可以用粘贴的方法将显示的图像粘贴到其它可用的 Windows 软件如 Microsoft Word 文件中。

KINEMATRICS-SUPPLIED SUPPORT PROGRAMS

KINEMATRICS 提供的支持程序

Kinematics supplies the following support programs to both covert data and to use as the basis for your own data retrieval and analysis programs.

Kinematics 公司提供以下支持程序，用于转换数据和用于基础的数据采集及分析程序。

Data in .EVT files is in binary A/D counts, +/- 8,388,608. 事件文件中的数据是二进制的。数模转换的范围为+/- 8388608。

QLCA	Graphically displays .EVT files (runs in 286 protected mode). 以图形方式显示记录的文件.EVT (运行在 286 安全模式下)。
KW2ASC	Converts .EVT files to ASCII floating point. One channel per output file. Full source code provided. 将.EVT 文件转换为 ASCII 浮点数字格式，每一个通道输出一个文件，并提供全部源代码。
KW2CNTS	Converts .EVT files to ASCII. Counts decimal, hex, or volts. One to six channels per output file. 将.EVT 文件转换为十进制、十六进制或电压表示的 ASCII 码。每个.EVT 的输出文件可多达 6 个通道。
KW2SUDS	Converts .EVT format to the SUDS binary format. 将.EVT 格式转换为 SUDS 二进制格式。
KW2V1	Converts .EVT format to the .DAT format for entry into the VOL1 program, which does double integration, acceleration-> velocity -> displacement. Allows user correction of sensor sensitivity. 将.EVT 格式转换为 DAT 格式并进入 VOL1 程序，进行二次积分，可将加速度变为速度、位移。允许用户修正传感器的灵敏度。
KWNTTP	Displays histograms of channels of recorded noise or other data; runs in 286 protected mode. 显示通道记录噪声或其数据的直方图，运行在 286 安全模式下。 <i>Note: Use of KWNTTP with the Makalu is not recommended.</i> 注意：不推荐使用将 KWNTTP 程序用于从前的诸如 Everest 的文件。
KWPARD	Displays or prints an ASCII formatted instrument parameter file from a binary .PAR file. 从二进制.PAR 文件中显示或打印一个 ASCII 格式的仪器参数文件。
KWPHF	Displays or prints an ASCII formatted event header file from an .EVT file. 从一个.EVT 文件中显示或打印一个 ASCII 格式事件的头文件。

KWSUM	Displays a summary of an .EVT file in the same format as the instrument terminal window summary command. 在相同的格式下，在仪器终端窗口命令摘要中显示一个.EVT文件的一览表。
KWTC	Analyze the time in an .EVT file's frame headers. Also can display the timecode bitmap in the frame headers. If the timecode is IRIG-E, it will attempt to decode it. 在一个.EVT文件的帧头中分析时间。在帧头中也能显示时间代码位图。如果时间代码是 IRIG-E，它还将尝试破译它。
KWTRIG	Applies a selected trigger filter to an .EVT file and writes an output file of the filtered data, a .TRG file. 应用一个选择好的触发滤波文件处理一个.EVT文件，并将滤波后数据形成一个.TRG文件。

A .TXT help file supplied on the package disk documents each of these programs. 这是一个帮助文件，上述各个程序都在磁盘的软件包中。

SUPPORT SOFTWARE FOR THE MAKALU 用于 MAKALU 的支持软件

Altus support software and the Strong Motion Analyst (SMA) have been updated to support the Makalu. The .EVT file format is the same as that of the K2 with the exception of the full-scale value and the clip indicator. Versions that support the Makalu are:

DOS Support, Package 302162, Rev. F (or higher).

Windows Support Package 302161, Rev. H (or higher).

QTWIN version 2.15, and QLWIN version 2.84 (or higher).

Strong Motion Analyst, version 2.2 (or higher).

The *QTPKT Packet Mode Demonstration Program*, P/N 302217 is available on special request from Kinometrics. This program, supplied with full source code, gives examples of sending and receiving binary packets in the Altus Packet [Block] mode communications.

It also demonstrates the beginnings of a C program to use the serial data stream transmissions of data packets. Sixteen .LG log files are supplied as examples of both sides of the dialogs. QTPKT can also be used to communicate with an instrument in the terminal mode.

Block Mode and Serial Data Stream Communications, (P/N 302218), documents the binary packets and QTPKT. This manual and the QTPKT program are essential if you are going to write your own program to deal with the binary packets.

Terminal-Monitor Mode Communications Manual, (P/N 302219) documents all of the terminal window commands for the K2, Mt. Whitney, Makalu and Etna instruments.

KINEMATRICS' STRONG MOTION ANALYSIS PROGRAM

KINEMATRICS 公司的‘强震动分析程序(SMAP)’

Kinematics' *Strong Motion Analyst* is an all-in-one interactive data analysis tool designed to help earthquake engineers, seismologists, and academic researchers process accelerograms recorded by strong-motion accelerographs. SMA features instrument correction, ground motion integration, Fourier and response spectra calculations, and V1, V2, V3 file format output. Contact Kinematics for more information on this program. Kinematics 公司的“强震动分析”是一个整体又相互配合的数据分析工具，它可帮助地震工程师、地震学家和高等院校的研究工作者处理强震加速度记录。SMA 强震记录分析程序的特点是包括仪器的校正、地面运动积分、富里叶谱和反应谱的计算以及 V1、V2、V3 文件格式的输出。如想更多地了解程序方面的信息，请与 Kinematics 公司联系。

The Makalu is supported in Strong Motion Analyst version 2.2 or above.

Network Management System 网络管理系统

Kinematics' Network Management System (NMS) assists in the collection and storage of event files or continuously transmitted digital data from remote Altus recorders. NMS is highly suitable for use in small to medium size networks. Kinematics 的台网管理系统 (NMS) 帮助收集、存储事件文件或从远程 Altus 记录仪中连续不断地传输数据。NMS 非常适用于中小型台网。

NMS, which runs on Windows 2000, Windows 95, Windows 98, Windows NT or Windows ME, supports up to 16 serial ports, and if using modems in event dial-up mode, a configuration of more than 16 recorders is possible. In event mode, **NMS** automatically gathers data from recorders and can help manage their storage. **NMS** 运行于 Windows2000、Windows95、Windows98、Windows NT，连续支持 16 个串行口或 TCP/IP 端口。如果用 Modem，且恢复事件时用拨号模式，也允许用在大于 16 台记录仪的台网中。在事件模式下 **NMS** 自动呼叫，可从记录仪中收集数据，并帮助管理和存储。

While **NMS** is operating in "streaming data" mode, the software will monitor a small to medium sized network and detect and store the state of the network, much like a large recorder. It can also automatically execute external software to process the data. In addition, the software recovers errors to compensate for bad connections or when one part of the network experiences communication delays. 当 **NMS** 工作在数据流模式时，该软件可用于监控中小型台网，并能监测、存储台网的工作状态，很像一个大型记录仪。它也可以用外部软件来处理数据。另外，由于连接的损坏或台网和一部分受到通讯延误而发生错误时，该软件可以修复、校正。

NMS supports the Kinemetrics Serial Data Streams (SDS) protocol and operates in one of two modes: **NMS** 支持 Kinemetrics 公司的串行数据流 (SDS) 协议并可以在两种模式的任何一种下运行：

- Takes reports of earthquake events from Altus recorders and automatically gathers event files (the data) and acceleration peaks in near real time to a PC that is either directly connected or connected through a modem. 通过 Modem 联接 PC 机和记录仪（或直接连接它们），能够准确实时地将 Altus 记录器中的地震事件形成报告，并且自动收集事件文件和加速度峰值。
- Takes continuously transmitted digital data from Altus recorders (maximum of six channels per recorder). It can display data in real time and do centralized triggering from the data being transmitted from the recorders, and stores the information at a local PC. 将 Altus 记录仪中数字数据持续不断地传出去（每台记录仪最多允许六个通道）。它能实时显示数据并实现中心触发，也能在一台本地 PC 机上存储信息。

Short Message Service 短信息服务

Some wireless digital phones and service providers (Pacific Bell, Sprint, etc.) conforming to the GSM digital standard support an optional service called Short Message Service, or SMS.

SMS allows the sending of messages up to 70 characters over a secondary data link. The message, originated at the Altus and transmitted through the phone, is typically redirected by the service provider to the Internet and arrives as an e-mail message.

Altus software allows for transmission of event detection messages consisting of station ID, trigger time, duration, and channel peaks using the SMS connection. For details, see the description of SMS support in the *Altus Monitor Mode Communications* manual, document 302219.

一些无线数字电话和设备的供应商（如 Pacific Bell Sprint 等），为了适应 GSM 数字标准，支持短信息服务或 SMS 的可选外设。SMS 可通过附属资料链发送多达 70 种信息，包括由 Altus 仪器产生的、通过电话线送到供应商的信息，就像 e-mail 一样互送信息。

Altus 软件设计了这样的功能：把诸如台站 ID 号、触发时间、持续时间、信道记录峰值等信息通过 SMS 连接发送出去。详情参阅 *Altus 监控模式通讯方法*（文件 302219）。

Troubleshooting 故障排除

Refer to the *Common Problems* section in the *Using QuickTalk & QuickLook Software User's Guide* for instructions on how to troubleshoot your recorder installation. If you are at a remote installation and cannot get the recorder to

respond, there is an alternative reset command. If the recorder receives this command it will reset. With the communication link open, type **\$\$Reset\$\$** (the case is important). If the recorder is responding to the serial port it will reset, which may allow you to re-establish communications.

参见 *QuickTalk* 和 *QuickLook Software 通讯软件用户手册* 中的 Common Problems 章节，说明如何检修记录器安装故障。如果你是远程安装，且不能获得记录应答信息，这里有一条可选重新设置的命令。如果记录器接收到这个命令它将重新设置：

打开通讯连接（Communication Link）输入 **\$ \$ Reset \$ \$**（这种情况很严重），如果记录器串行口有反应，它将重新设置，这种方法也可以帮助你重新建立通讯。

4. Maintenance & Service 维护和服务

Overview 总论

In this section we discuss recommended maintenance and service procedures. Regular maintenance is important not only to check the performance of the instrument, but also to verify that your setup is correct and that local conditions have not changed. Kinometrics can provide training on these procedures, and set up a preventive maintenance program.

If you prefer to set up your own maintenance program, we suggest you follow the recommendations below. You should maintain your network on a consistent basis in order to provide the highest quality data.

本章介绍维修和服务的问题，并提出一些使用的 Kinometrics 公司已有成果的建议。正规的维修，不但对于检查仪器工作状况，而且对于校验仪器设置是否正确以及现场工作环境是否改变都是至关重要的。对此 Kinometrics 公司能够提供一系列建议使用的成果并提出一套预防故障的维护方法。

如果你宁愿建立自己的一套维护程序，我们希望按如下维修原则。为了取得最高质量的数据，你应保持你的网络具有稳定一致的工作环境。

Performing a Three Month System Check 完成三个月的系统检查

During the first three months after installation, you should verify the operation of the recorder to make sure the instrument is configured correctly and that the installation is functioning properly.

At three months, we recommend that you visit the recorder site and follow the procedures described in the *Regular Maintenance Check* section. This will allow you to see how the equipment is functioning, and if the conditions at the

site are as you expect. A remote systems check cannot tell you if the unit is submerged in muddy water!

If you still wish to perform the check remotely, see the *Remote Systems Check* section.

At this time you may also want to decide whether the instrument parameters are optimally set to meet your scientific objectives. If you wish to revise the instrument settings, refer back to the *Setting Instrument Parameters* section in Chapter 3.

在仪器安装好之后的 3 个月期间，你应该校验其功能，设置一定要正确并合理安装了仪器应具备的功能。

到 3 个月结束时，我们希望你能到记录仪现场去，按正规维修检查章节讲述的步骤逐一检查，看设备的功能如何，其工作环境是否得到保证。用远程遥控检查是不能知道仪器是否遭受水浸的。

如果你坚持用遥测检查方法，请参阅遥测系统检查章节。

这一次你也许要做出决定，使仪器的参数设定最符合你课题研究的需要。如果这时想修正参数设置，请参阅第 3 章设置仪器参数。

Performing a Regular Maintenance Check 完成常规维护检查

Follow the procedure described below for the initial three-month system check and subsequent site visits.

If your unit cannot be contacted via modem, we recommend that you perform the following on-site maintenance check every six months.

Note: If you can use a modem connection to complete a system check remotely, we recommend that you do an on-site maintenance check every 12-18 months, depending on local weather and geophysical conditions.

If your recorder is located where growing vegetation could cover antennas or solar cells, you will need to check the site more frequently.

初用的 3 个月系统检查和安装环境巡视的过程如下。

若你的仪器不是经 Modem 连接的，我们建议每 6 个月逐点巡视检查一次。

注意：如果能通过 Modem 进行遥测检查，我们建议每 12-18 个月逐点检查一次（依据具体安装地点的气候和地球物理环境而定）。

若记录器安装地点处于植被良好地区，那么你应该多去检查以免树枝覆盖了天线或太阳能电池板。

Step 1 Run Remote Check Tests 第一步：运行远方检查试验

When you make an on-site visit, complete the tests described in the *Remote System Checks* section. The only difference is, when running the system-voltage check; unplug the mains supply to the unit, thus forcing it to run on its backup batteries. Watch the internal battery voltage carefully.

If the battery is fully charged, the voltage should drop rapidly to about 12 volts and stay there. If the voltage drops within a few minutes to less than 11.7V, either the battery was not completely charged, or you need to replace the battery with a newer one.

Use a DVM to obtain a more accurate voltage just by measuring the voltage across the battery terminals while the battery powers the unit.

Under normal operating conditions, we recommend that you replace the battery every three years. Refer to the *Replacing Batteries* section for information on how to do this.

到每一个仪器安放点都要按照进行遥测系统检查章节讲的方法进行检查，唯一不同处在于此时要拔下交流电源插头，检查依靠系统后备电池工作的情况并测量运行时的电池电压。

若电池是充满电的，电压值约为 12V 并稳定于此值，若经过数分钟以后，降低到 11.7V 以下，不是电池未充满电就是电池老化需要换新的了。

使用 DVM 命令能获得更加精确的电压值（比用万用表跨接于正在供电的电池两极准确得多）。

在正常的操作条件下，我们建议每 3 年更换一次电池。参阅更换电池一节有具体说明。

Caution: Reconnect the power supply after completing this test.

告诫：完成上述试验后，一定别忘记再插上电池充电器！

Step 2 Adjust the Accelerometers 第二步：调节加速度计

If the offset of the internal EpiSensors measures more than 5 milli-g they should be adjusted. Chapter 2 contains adjustment instructions. 如果内置式传感器的偏差大于 $5 \times 10^{-3}g$ ，那么就應該校准传感器（见第 2 章）。

Step 3 Replace the Desiccant 重置干燥剂

To help maintain low humidity inside the recorder's enclosure, Kinometrics places a packet of desiccant inside to absorb any water vapor, as well as a humidity indicator label that gives an approximate reading of the humidity level. We normally place both items beside the battery, in the battery compartment at the rear of the unit.

Check the indicator during every on-site visit: if the 50% relative humidity indicator dot is pink, replace the desiccant. We recommend that you replace the desiccant every 12-18 months. You can order new desiccant packets and humidity indicators (P/N 700049) from Kinometrics.

Kinometrics 公司为保持记录仪器盒内的低湿度环境，出厂时在其中放了干燥剂和指示试纸，前者可以吸收盒内的水份，而指标试纸能表示盒内的湿度，我们通常每次都要换掉位于电池旁边的干燥剂和尾部（也在电池舱内）的湿度指示试纸。

这样判断各仪器安放点的干燥剂是否应该换；如果相对湿度达到 50%，干燥剂上的小圆点就变为粉红色，说明应换。建议每 12-18 个月更换一次。新的干燥剂和指示试纸（P/N 700049）可以从 Kinometrics 公司订购。

Step 4 Complete a Functional Test

Before Leaving the Site 临离现场前完成一次功能试验

Before leaving the site, retrieve and then delete any old files on the recorder's storage media. Next, perform a functional test and an SRT to leave data recorded in the unit.

Next, perform a functional test and/or an SRT and retrieve the files, leaving them stored on the unit for the next visit. This will allow verification of sensor parameters before and after subsequent events are recorded. Make sure to reconnect any cables and telecommunications equipment that has been serviced, and check that the main supply is connected. This is where your personally prepared procedure and detailed checklist can save you a repeat visit — or worse, a unit that will not operate until your next service visit!

离开站点前，恢复记录仪里的事件文件，再删除记录介质中的旧文件，然后进行一次功能试验（标定）和（或者）STR（分段测试）并恢复这些文件，最后将这些文件留在记录仪中以便下次检查时对照校验传感器的参数，同时，这个试验结果说明了当前传感器的灵敏度，为

以后记录的事件文件留下一个参照。一定要记着恢复所有电缆的连接，包括原来使用正常的远程通讯设备。检查交流电源插头是否插好。这个站点就是你制定的详尽检修项目具体落实的地方，稍有疏忽会使你再跑一趟，甚至更坏——直到你下次再来之前，它就不工作！

Performing a Remote System Check 完成远方系统检查

If your recorder is equipped with an internal PCMCIA modem or an external modem (or some other type of telecommunications link), you can remotely check its operations.

A remote check allows you to perform routine maintenance checks for the cost of a telephone call. We recommend you perform a remote check at least once every three months; it is an easy and inexpensive way to make sure the recorder is working. Many users perform this check on a weekly basis, to ensure their network is operating optimally.

To perform a remote system check, first connect to the recorder modem as described in *Phoning Your Recorder*, using either QuickTalk or your own communications package. Before you begin the remote check, retrieve any new event files from the recorder and store them on your PC.

Note: The following instructions assume you are familiar with QuickTalk and with the use of Terminal window commands. Refer to the *QuickTalk & QuickLook Software User's Guide* if you are unfamiliar with the QuickTalk interface.

如果记录仪配置了内插的 PCMCIA Modem 卡或外接的 Modem（或其它种类的远程通讯链路），则可以对仪器进行遥测检查。

遥测检查使你仅花费电话费就可以进行一次例行维护检查，建议至少每 3 个月进行一次例行检查，因为它简单易行而花费又少却可以确定 Etna 是否有问题。许多用户基本上是每星期做一次远程遥测检查以确保他们的网络运行良好。

遥测检查：首先像“应答模式：呼叫 Etna”中叙述的那样连通记录仪的 Modem，使用 QuickTalk 或你自己的通讯软件包都可以。开始遥测检查之前，把记录仪记到的所有新事件文件恢复到你的 PC 机里。

注意：下述维修过程的叙述，假定你熟悉 QuickTalk 软件并且会使用终端窗口命令。否则参阅 *QuickTalk 和 QuickLook 软件用户手册*。

Step 1 Functional Test & Sensor Response Test

第一步：功能试验和传感器反应试验

Select **Recorder**, **Acquisition Control**, and **Functional Test** to run a functional test on the unit.

To perform a Sensor Response Test, open the Terminal window:

Enter **AQ OFF**

Enter **AQ SRT**

Enter **AQ ON**.

Retrieve the event files generated by these tests, then use QuickLook to make sure the records look correct. If they do, you have confirmed that the system can trigger and that the sensors are operational.

在主菜单中的，点击记录仪（**Recorder**）——采集控制

（**Acquisition**）——功能试验（**Functional Test**），可以对远程记录仪发出功能测试指令。

也可以打开终端窗口，进行传感器响应试验：

键入 **AQ OFF**

键入 **AQ SRT**

键入 **AQ ON**

恢复这些由功能试验所形成的事件文件，再用 QuickLook 查看这些波形是否正常，如果正常，你就可以确定系统能够触发并且它的传感器也是正常的。

Step 2 Checking Sensor Offsets 第二步：检查传感器的零位偏离

Check the sensor offsets by looking at the functional test record, or,

Enter **AQ DVM** in the Terminal window

For a 12-channel K2, specify which group of channels you want to look at.

```
* aq dvm
```

```
Press 'C' to clear accelerometer offset voltage,
```

```
Press 'S' to toggle accelerometer step voltage,
```

```
Press 'Z' to zero, or press any other key to quit.
```

```
1: -0.080 0.231 0.854 -0.006 -0.004 -0.005 mV
```

The unit displays a real-time reading of the voltage of its input channels in millivolts. For EpiSensors, we recommend that the offset be less than ± 5 milli-g. Refer to Table 1 for the 5 milli-g level in each of the possible deck

configurations. If the offset exceeds this value, you may need to make a field visit to adjust the EpiSensor accelerometer offsets. The procedure for adjusting the offset is described in Chapter 2 for internal EpiSensors and in the EpiSensor manual for adjusting external EpiSensors.

通过功能试验记录图查看传感器的偏差，或者在终端窗口键入 AQ

DVM，终端窗口显示内容：对于 12 通道 K2，须指明你要看的那些通道。

```
* aq dvm
```

Press C 压 C 键可以清除加速度计偏差电压，

Press S 压 S 键可以触发加速度计的步进电压，

Press Z 压 Z 键可以使之归零，或，压任意键退出该条命令。

```
1: -0.080 0.231 0.854 -0.006 -0.004 -0.005 mV
```

在终端窗口上则显示实时数据，即该道输出的电压值（以 mV 为单位）。对于 Etna 内置的 EpiSensors 传感器，我们建议的标准为：偏差小于 $5 \times 10^{-3}g$ 。如果偏差超过此值，你或许应该到现场去校准该加速度计的偏差，方法是第 2 章“内置 Epi 传感器”和“EpiSensor 手册的校准外部 Epi 传感器”一节。

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The AQ DVM command will show values up to full scale (slightly less than 20000.000 mV).

Step 3 Checking System Restarts 第三步：检查系统的重新启动

Enter **STA** in the Terminal window to check on the system status. The system displays a message similar to this:

```
Status for Recorder S/N 675
Restart Counts: 235 (reset status: 20)
Restart Time: Apr 17, 1997 19:30:52.000
Current Time: Apr 17, 1997 19:51:37.000 (GPS)
GPS: ON
Events: 2 (Errors: 0)
Acquisition: ON (NOT TRIGGERED)
Alarm: NOT TRIGGERED
Battery: 13.0 V
Temperature: 32.2 C
PEM Banks: 1
Drive A: 20 MB FREE B: NOT READY
*
```

This screen allows you to check the unit's temperature and battery voltage, and verify that the timing works and is being synchronized by GPS. This screen also indicates the memory available on the PCMCIA drive, and how many events have been recorded since the last time you cleared the event counter.

Compare the entry in the *Restart Counts* field with the count at your last maintenance visit. Each time the reset count is incremented, it means the system went through a reset due to either loss of power or some other event. The cause of the last reset is shown as the reset status.

Be aware of these two codes:

- *Code 80H* indicates either the power to the recorder was turned off or the recorder lost power. If you didn't turn off the power, this means the recorder probably lost power for a long-enough time to discharge the battery backup. You should investigate why this happened.
- *Code 20H* indicates the recorder reset itself, from either a software watchdog reset or a user-initiated system reset. If the recorder resets itself frequently, it may have a hardware problem and you should contact Kinometrics Technical Support.

在终端窗口输入 STA 命令来检查系统状态，系统显示类似下面一段信息：

Status for Recorder S/N 675

Restart Counts: 235(reset Status: 20)

Restart Time: Apr 17,1997 19:30:52.000

Current Time: Apr 17,1997 19:51:37.000(GPS)

GPS: ON

Events: z (Errors: o)

Acquisition: ON (NOT TRIGGERED)

Alarm: NOT TRIGGERED

Battery: 13.0V

Temperature: 32.2C

PEM Banks: 1

Drive A: 20MB FREE B: NOT READY

*

这些显示可使你检查记录仪的温度和电池电压，检验它被 GPS 同步的开始时间和系统时间。屏幕也显示 PCMCIA 卡当前有多大空间可以利用以及自从你上次清理事件计数器之后，又记录了多少个事件。

将你上次维护时记录的数字，与重启动计数字段处的条目数相比。每重新启动一次这个记数均被增加，这意味着由于掉电或者某些其它事件曾引起过系统重新启动。最后一次重新启动的原因就在上述屏幕显示的“重启状态”中透漏出来。

要意识到这两个码（在屏幕显示的重启状态字段）的含义：

- 代码 80H 指示两个原因造成的重启，要么是记录仪的电源曾被关闭过，要么记录仪掉电了。是要你并不曾关过电源，很可能是很长时间未给电池充电而电池的电又用完了。你最好调查一下为何如此。
- 代码 20H 指示系统记录仪自己重启了。重启原因也许是由于看门狗软件，也许是由于用户重新初始化系统所致。若记录仪自己反复多次重启动，或许出现了硬件问题，你应该与 Kinemetrics 公司技术支持部门联系。

Step 4 Checking System Voltages 第四步：检查系统的电压

From the QuickTalk Terminal window, enter **DG** to start Diagnostics Mode. When you see the Diagnostic Prompt (*DG>*), enter **ADC**. The unit displays a list of 8 numbers like this:

Starting CPU16 ADC...

Press any key to abort

1	2	3	4
13.330V	0.019V	22.741C	000H
5	6	7	8
23.882V	12.080V	13.410V	0.078V

These numbers indicate the recorder's current system voltages and temperature. Check whether the numbers on your screen fall within the acceptable ranges in Table 4.

Note: The shaded numbers above (1, 2, 3, 4, 5, 6, 7, 8) will not appear on your screen. They correspond to the numbers in the far left column in Table 4.

从 QuickTalk 终端窗口输入 DG 进入诊断模式，当你看到诊断提示符（DG>）后，键入 ADC，系统显示类似下述的一段顺序信息：

Starting CPU16 ADC...

Press any Key to about

1	2	3	4
13.330V	0.019V	22.741C	000H
5	6	7	8
23.882V	12.080V	13.410V	0.078

显示在你的屏幕上的这些数字，指示记录器当前的系统电压和温度。
检查它们是否符合表 4 给出的正常值范围。

注意：上述信息中阴影部分的数码（1,2,3,4,5,6,7,8），在你的屏幕上是没有的。它们的含义见表 4 左栏（序号）。

Table 4: Acceptable voltage ranges for an operating recorder

No. 序号	System Variable 系统参量	Range 范围	Minimum 最小值	Maximum 最大值
1	-12V Switched Voltage 开关电压	0-20 VDC	10.5	14
2	Not Used 无用	Ignore screen readings 忽略屏幕显示值		
3	Temperature 温度	-39 to +89°C	-20°C	+70°C
4	Not Used 无用	Ignore screen readings 忽略屏幕显示值		
5	Charger Voltage 充电电压	0-35 VDC	18 VDC	25 VDC
6	Internal Battery 内电池	0-20 VDC	11.5 VDC	14 VDC
7	External Battery 外电池	0-20 VDC	11.5 VDC	14 VDC
8	Not Used 无用	Ignore screen readings 忽略屏幕显示值		

表 4 运行的记录器可以接受的电压范围

If the recorder is operating correctly, all the voltages should be within the limits shown above.

If the voltages are too high or too low, the unit requires service. If the charger voltage is too low, there might be a failed power supply or insufficient AC power. If the internal or external battery is too low, there might be a charger or an AC power failure. There might also be a problem with the solar power supply, if one is in use. Visit the recorder site to determine the cause of the problem.

Press any key to return to Diagnostics Mode.

如果记录器正常运行，所有数据都应该符合上表。

如果电压太高或太低，记录仪系统则需要维修。如果充电电压太低也许是电源补充失效或交流电压太低所致。如果内部或外接电池的电压过低，则可能是没有交流电或充电器失效。但如果使用的是太阳能电池供电，则可能是太阳能供电系统的问题。应到现场去确定问题的根源。

敲任意键可返回到诊断模式。

Step 5 Checking GPS Condition 第五步：检查 GPS 状态

If your recorder has a GPS timing system, it should also be checked. While still in the Diagnostic Mode, enter **GPS ON** and then enter **GPS DIA**. The first command ensures that the GPS is powered up, and the second causes the screen to display specific information about the GPS system.

If the GPS was not already powered up, it will need a couple of minutes to acquire satellites. You can monitor its progress as it acquires satellites and then calculates time and position fixes.

Wait a few minutes and enter **S** to check the signal strengths of the satellites. The display will look something like this:

```
[47]SNR for satellites: 6
SV  7   5.89
SV  4  12.45
SV  2  12.41
SV  9  14.27
SV 26   3.40
SV 24   0.00
```

The display above shows that the GPS is acquiring six satellites, and three of them have good signal-to-noise ratios greater than 10 (see the right-hand column). If these numbers are all below 10, or are zero, it means you have a problem with either the GPS receiver or, more likely, the antenna and/or its position.

Enter **Z** to view the following screen information:

```
DG> gps dia<cr>
Power is ON (Free Field Mode)
No. of RTC Updates: 1
No. of Failed Locks: 0
Last GPS Lock At   : May 11, 2000  11:30:40.000
Last RTC Update At: May 11, 2000  11:29:12.000 (Drift: < 1 ms)
Last Powered Up At: May 11, 2000  11:34:33.000
Last GPS Lock At   : May 11, 2000  11:29:14.000
Last RTC Update At: Jan 01, 1980   00:00:00.000 (Drift: < 1 ms)
Last Powered Up At: May 11, 2000  11:28:08.000
Last Position:      34.139999N -118.099998E 208m
Average Position:   34.148647N -118.102386E 208m 9 samples
Will Power Down At: May 11, 2000  12:04:33.000
Next Power Up Time: May 11, 2000  12:04:33.000
DAC Value (Current): 2396
DAC Value (Dithered): 2395.2
DAC Value (in EEPROM): 2373
GPS antenna: OK
Commands:
H=health; S=signal levels; T=time, Z=GPS Status,
C=Clock Sync, F=GPS F/W Version, Q to quit
```

Look at these status readings carefully, because they contain important information.

"Mode" describes the GPS operating mode (free-field, master or slave) and is set with the EDIT mode command GPS.

"No. of RTC Updates" -- A large number of clock updates indicates the recorder has to resynchronize the clocks when it gets a lock;

"No. of Failed Locks" -- A large number of failed locks indicates the GPS is having difficulty acquiring satellites.

- Both types of readings suggest bad antenna placement. Another possible cause of a large number of RTC updates is that the "Power On" interval is too long and the oscillator has drifted more than $\pm 500\mu\text{s}$.

"Last GPS Lock At" -- If the GPS successfully locked to satellites, the screen should display the last two times the GPS made time locks and the last two times the GPS powered up " Last Powered Up At."

"Last Position" and "Average Position" -- Indicate the position of your unit to a high degree of accuracy. You can use this information to fill in the unit's latitude and longitude.

"DAC Value" entries show the DAC values used to control the voltage-controlled oscillator frequency. These values can range from 0 to 4096 counts, but if the unit is working correctly and the temperature is close to 20°C , they should range from 1250 to 2750 counts.

"GPS antenna" describes the electrical status of the antenna. The status will be either OK or open/short.

This completes the remote system diagnostic check.

Now, retrieve and then delete old files, leaving only the last functional test and SRT on the recorder for reference.

Enter **Q** to exit Diagnostics Mode.

Finally, end the call as described in the *Connecting a Recorder to the Modem* section in Chapter 2 of the *QuickTalk Users Guide*.

如果记录仪配有 GPS 适时系统，它也应该列入检查范围。这时如果仍在诊断模式，键入 **GPS ON**(回车)，然后键入 **GPS DIA** (回车)。上述第一条命令是给 GPS 上电，第二条命令是屏幕显示 GPS 系统的特殊信息。

如果 GPS 原来没有上电，则它还需要几分钟来搜索卫星。你这时可以监视系统搜索卫星和计算时间和定位的过程。

等待几分钟后，键入 **S** 可以检查卫星信号的强度。屏幕显示类似于：

```
[47]SNR for satellites: 6
```

```
SV    7    5.89
```

```
SV    4    12.45
```

```
SV    2    12.41
```

```
SV    9    14.27
```

SV 26 3.40

SV 24 0.00

上述显示说明搜索到 6 颗卫星，其中 3 个的信噪比超过 10（见右侧第一栏），如果它们都小于 10 甚至为零，则意味着 GPS 接收器、更可能是天线及天线的位置有问题。

键入 Z 去看下列屏幕信息：

DG> gps dia (回车)

Power is ON (Free Field Mode)

NO. of RTC Updates: 1

NO. of Failed Locks: 0

Last GPS Lock At: 月 日 年 时 分 秒

Last RTC Update At: 月 日 年 时 分 秒 (Drift: <1ms =

Last Power Up At: 月 日 年 时 分 秒

Last GPS Lock At: 月 日 年 时 分 秒

Last RTC Update At: 月 日 年 时 分 秒 (Drift: <1ms =

Last Power Up At: 月 日 年 时 分 秒

Last Position: 纬度 经度 高程

Average Position: 纬度 经度 高程 样本数

Will Power Down At: 月 日 年 时 分 秒

Next Power Up time: 月 日 年 时 分 秒

DAC Value (Current): 2396

DAC Value (Dithered): 2395.2

DAC Value (in EEPROM): 2373

GPS antenna: ok

命令 H=health; S=Signal levels; T=Time; Z=GPS Status; C=Clock Sync, F=GPS F/w Version ; Q=退出

仔细阅读这些状态参数，因为它们包含重要信息。

“ Mode ” 描述这套 GPS 系统的工作模式（自由场、“主”、“从”GPS 模式之一），并且被设置成了带有编辑功能的 GPS 命令。

“ NO. of RTC Updates ” 若显示更新时钟的一个很大的数字，提示记录仪进入对钟过程，时间系统正在重新同步。

“ NO. of Failed Locks ” 若显示时钟锁定失败的一个很大的数，提示 GPS 很难搜索到卫星。

上述两条信息均说明天线的位置不合适。RTC（更新时钟）出现很大数字的另一个原因是“GPS 供电间隔”设置得太长，振荡器漂移时间超过 500ms。

“ Last GPS Look At ” 一行文字的信息含义：如果 GPS 成功地锁定卫星，屏幕上将显示 GPS 最后两次锁定的时间和 GPS 最后两次加电的时间（Last Powered Up At）。

“ Last Position ” 和 “ Average Position ” 信息指示记录仪的定位精度，你可以使用这条信息填写记录仪所在处的经纬度。

“ DAC Value ” 信息显示 DAC 的值，通常用于控制压控振荡器的频率。该值在 0 ~ 4096 之间。如果环境温度接近于 20 并且记录仪正常工作，这个值的范围仅在 1250 ~ 2750 之间。

“ GPS antenna ” 指示天线的供电状态，这个信息可能是正常（OK）或开路（open）/短路（short）之一。

至此就完成了遥测系统的诊断检查。

恢复已记录文件并删除记录仪中的旧文件，仅留下本次最后那个功能试验文件和 SRT 信息供今后参考。

键入 Q，退出诊断模式。

最后，中断遥测通讯（如 QuickTalk 用户手册的第 2 章“连接记录仪到调制解调器”所述）。

Replacing Batteries 置换电池

Because they lose their capacity over time, you should replace the internal batteries used in the recorder at regular intervals. Kinometrics recommends that you replace the batteries every three years in normal operating environments; more frequently if the unit's ambient temperature is significantly above 20°C. Read the *Safety* section before replacing the battery. 由于电池长年使用会失去容量，你应该定期给记录仪更换内部的电池。Kinometrics 建议在正常运行环境中，每 3 年更换一次。要是环境温度经常超过 20℃，要换得更勤些。换电池前请阅读“安全须知”。

Battery Specifications 电池特性



We strongly recommend that you purchase replacement batteries from Kinometrics. The battery is a 12V, 12 amp-hour sealed lead acid cell with Faston terminal tabs, 0.250" x 0.032", equipped with a pressure relief valve that meets UL924. 我们特别提醒，请从 Kinometrics 公司购买替换电池。标准的电池为 12V/12Ah (P/N 840503)，它是铅酸免维护蓄电池（带有 Faston 标签）。



WARNING! Fire or explosion hazard. Do not install a non-rechargeable battery in the recorder. Only install a sealed lead acid battery with specifications compatible with those above.

警告：火灾与爆炸的危险。 记录仪不能使用非充电电池，只能使用具有上述性能指标的铅酸蓄电池。

If you store a battery, you should still charge it every six to nine months to prevent permanent loss of capacity. You can float-charge the battery at 13.5-13.8V or cycle-charge the battery, provided the current is limited to less than 2.4 amps and the voltage to less than 14.7V.

When the voltage reaches 14.7V, the battery will be damaged unless you convert the cycle charging to float charging. Kinometrics ships batteries fully charged; make sure a battery is still fully charged before installing it.

储存的蓄电池，也必须每 6—9 个月充一次电，以防电池丧失容量。应该用小于 14.7V 的充电电压及 2.4A 以下的电流浮充或循环充放电。

除非使用浮充方式充电，蓄电池充电至 14.7V 将被损坏。Kinometrics 公司的电池可以保证在安装使用之前是充满电的。

Battery Installation 电池安装

Follow the instructions below and refer to Figure 24 to install a new battery. 依照下述方法及图示安装电池。

Caution: Before installing the new battery make sure it is fully charged. If the battery is uncharged, the recorder will charge it, but this can take some time — and if AC power is lost, the unit's power autonomy will be reduced.

告诫：安装新电池之前，一定要先将电池充满。否则，新电池安装之后，记录仪将给它充电，有时（如果交流电没有供给）会使系统的自备电能减少。

Install a new battery inside the recorder as follows:

1. Switch the recorder's *OPER/STBY* switch to **STBY**.
2. Remove the external power connector.
3. Disconnect the positive terminal (red wire) from the existing battery.
4. Disconnect the negative terminal (black wire).

WARNING! Burn or explosion hazard. Never place metallic objects (such as a screwdriver or your wristwatch strap) across the terminals of a battery. The metal terminals can get very hot. Handle batteries with care, and do not drop them or attempt to take them apart. Recycle used batteries, or dispose of them in accordance with local regulations. Do not throw used batteries onto a fire.

警告：燃烧或爆炸的危险：千万不要把金属器具放在电池上（像钳子、解锥之类）。金属短接将会产生高温。拆下电池时要小心，切勿使其摔到地上，也别拆卸分解电池，更不能把用过的电池放入火里，只能上交回收部门或者按当地规定处理它。

5. Unscrew the two screws on the battery bracket.
6. Remove the battery bracket.
7. Remove the old battery.

8. Make sure the rubber battery pad remains within the recorder (this pad keeps the battery from moving during transport).
9. With the same orientation, insert the new battery into the unit.
10. Reinstall the battery bracket and pad, and carefully retighten the screws.
11. Connect the negative terminal (black wire).
12. Connect the positive terminal (red wire).
13. Switch the *OPER/STBY* switch to **OPER**, and make sure the recorder functions properly.
14. Reconnect the external power connector to the recorder.

如下步骤安装内部电池：

1. 将天关扳到 **STBY** 档；
2. 拔除外接电池插头；
3. 拔下原有电池的正极（红色）接线；
4. 拔下原有电池的负极（黑色）接线；

警告：燃烧或爆炸的危险：千万不要把金属器具放在电池上（像钳子、解锥之类）。金属短接将会产生高温。拆下电池时要小心，切勿使其摔到地上，也别拆卸分解电池，更不能把用过的电池放入火里，只能上交回收部门或者按当地规定处理它。

5. 拧下固定电池的两只螺丝；
6. 卸下电池固定夹板；
7. 取出旧电池；
8. 一定要保证电池下面的橡胶垫保持原位（它起防震作用）；
9. 如上相反顺序安装、固定新电池；
10. 放好橡胶垫、细心放好电池并拧紧固定螺丝；
11. 连接电池负极（黑线）；
12. 连接电池正极（红线）；

13. 将 *OPER/STBY* 开关扳到 *OPER* 档，确保记录仪功能正常；
14. 重新将外接电源插到记录仪上。

图 24 内置电池部件

Figure 24: Internal battery components

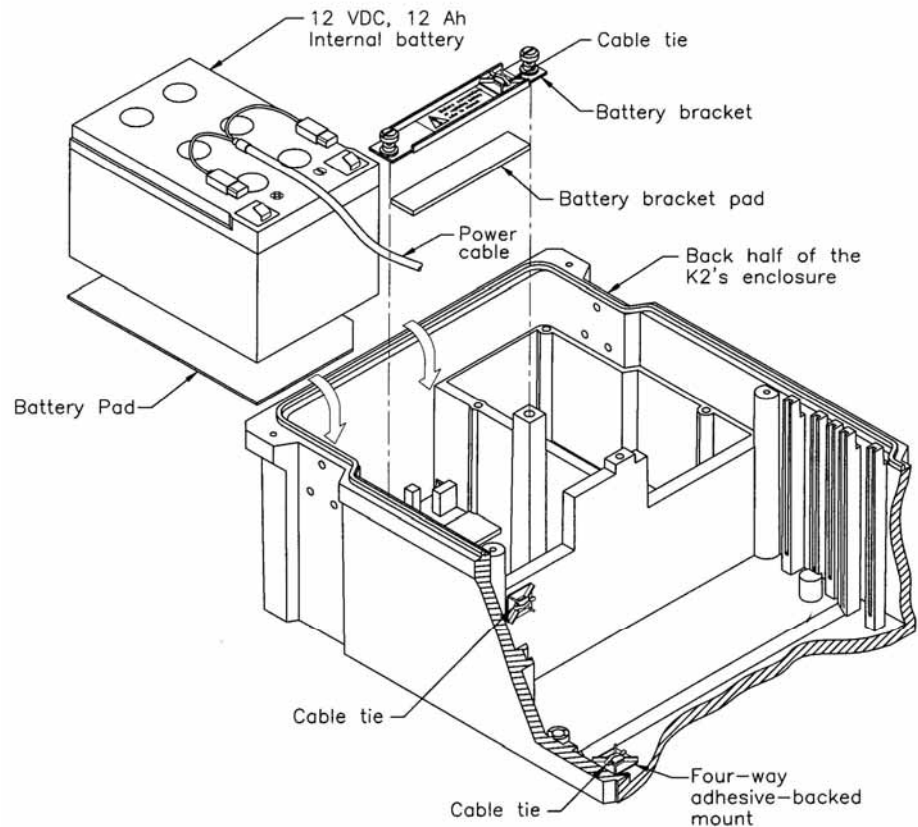


图 24 内置电池部件

Note: Depending on when your recorder was manufactured, the battery may be installed with the terminals at the back of the unit. If this is the case, replace the battery in this orientation and make sure the connections are made to the correct polarity terminals. We made this change to accommodate the grounding straps of recorders with I/O connectors in the lid.

注释：取决于当你的记录器是被制造，电池可与端子接线柱安置在仪器的后部。如果是这种场合，在此方向重装电池并确保连接做到极性端子正确。我们作此改变为容纳在盖中具有 I/O 连接器的记录器的接地条带。

Battery Recycling 电池回收利用

We recommend you recycle the sealed lead-acid cells used in the recorder; if properly recycled they are environmentally friendly. You should be able to recycle used batteries at the same centers that recycle automobile batteries. 建议将用于记录仪的免维护铅酸电池回收利用。回收利用有益于环境保护。或许你也能在回收汽车电瓶同一个中心里回收用过的电池。

Replacing Fuses 置换熔断丝

The K2 and Makalu have four 2AG-size fuses located at the top of the front-panel PC board. Looking at the front of the case, the fuses are numbered from right to left, F1 to F4. The PC board is also silk-screened with the reference designator of each fuse.

If the fuses blow, try to determine the reason why. If the reason was some problem in the servicing of the unit, then the fuse served its purpose and you should replace it. If fuses blow repeatedly, there is a problem with your installation, or with the recorder itself.

You can obtain spare fuses from Kinometrics, or from industrial electronic distributors.

K2 和 Makalu 记录仪的前面板后的 PC 电路板上 有 4 只 2AG 系列的保险丝管。从右到左依次为 F1、F2、F3 和 F4。PC 电路板也印上了这些保险丝管的标记。

如果保险丝管熔断，首先要寻找其原因。若查明是因为仪器用久而熔断，只要换上同型号的即可。但反复烧断，就可能是仪器本身或是你安装的问题了。

从 Kinometrics 公司可以获得备用的保险丝管，也可以从电子零件商店购到。



WARNING! Potential fire or electric shock hazard. Replace a fuse only with a fuse of the correct current, voltage and characteristic as specified in Table 6.

Disconnect all power to the recorder before replacing the fuses, including the mains supply, the internal battery, and any external batteries, to avoid risk of electric shock.

警告：潜在的火灾和电击危险：换保险丝只能使用同型号的（电流值相同，见下表）。在更换保险丝之前，断开所有的电源，包括主供电电源、内置式电池、所有外接电池，以免电击的危险。

Change fuses F1-F4 as follows:

1. Turn the *OPER/STBY* switch to **STBY**
2. Remove the red wire from the battery.
3. Disconnect the power supply from the unit.
4. Locate the blown fuse.
5. Use a plastic fuse-extraction tool to pry the fuse out from the clips.

6. Insert a new fuse with identical ratings (shown in Table 6).
7. Reconnect the red wire to the battery.
8. Reconnect the power supply to the unit.
9. Turn the *OPER/STBY* switch to **OPER**.

更换 F1-F4 保险丝的步骤：

1. 将开关扳到 **STBY** 档；
2. 从电池正极上拔下红线；
3. 拔下充电器的航空插头；
4. 判明烧断的保险丝管的位置；
5. 使用塑料制的保险丝管更换工具，将保险丝管从座上取出；
6. 插入新的保险丝管（见表 5 规格）；
7. 重新接通红色线至电池正极；
8. 重新接通充电器；
9. 将开关扳到 **OPER** 位置。

Caution: Potential equipment damage. All batteries and the PSA should be disconnected before you service the equipment because power is supplied to some of the circuit boards even when the *OPER/STBY* switch is in the **STBY** position.

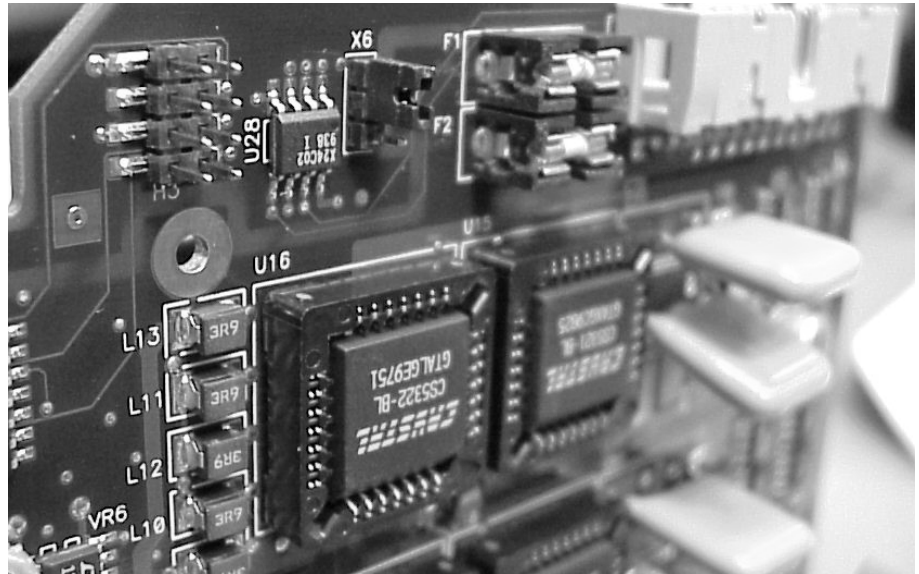
告诫：潜在的仪器损坏：开关即使在 **STBY** 位置，更换元件或维修也必须把所有电池、充电器等电源供给断开，否则，部分电路板仍然是有电的。

THE MAKALU

The Makalu also has two additional 1/8 Amp fuses located next to the 20-pin sensor interface connector on the Makalu's ADC/DSP board (Figure 25).

Figure 25: EpiSensor fuses on an Makalu ADC/DSP board

To remove the fuses:



1. Disconnect all batteries and the PSA
2. Remove the ADC/DSP boards from the card cage
3. Remove the top shield assembly from the ADC/DSP board

图 25 在 Makalu 的 ADC/DSP 板上的 EpiSensor 熔断丝

Table 5: Fuses and ratings

表 5 熔断丝和额定值

CE	Fuse 保险丝管	Part Number 部件号	Rating 额定值	Description 描述
	F1	Littlefuse 225003 KMI 840507	2AG, 3 amp 250 V	Protects wiring and PCB traces associated with 24V charger. 保护外部 24V 电池充电器线路及线路板
	F2	Littlefuse 225003 KMI 840507	2AG, 3 amp 250V	Protects wiring and PCB traces associated with <i>external</i> +12V main battery. 保护外部+12V 主供电电池的线路及线路板
	F3	Littlefuse 225001 KMI 840524	2AG, 1 amp 250 V	Protects wiring and PCB traces associated with <i>external</i> +12V standby power source. 保护外部+12V 备用供电电源的线路及线路板
	F4	Littlefuse 225003 KMI 840507	2AG, 3 amp 250 V	Protects wiring and PCB traces associated with <i>internal</i> +12V main battery. 保护内部+12V



Fuse 保险丝管	Part Number 部件号	Rating 额定值	Description 描述
			主供电电池的线路及线路板
F1, F2	Schurter 010.9760.63 KMI 840935	1/8 amp	On the Makalu ADC/DSP board: Protect the +/- 13.75 power lines to EpiSensors

Replacing PCMCIA Cards or Hard Drives 置换 PCMCIA 卡或硬驱

Contact Kinemetrics for a list of the current capacities and types of available storage media if you wish to replace or upgrade the capacity of your PCMCIA storage. We will also give you a list of supported media that you can purchase yourself. (Kinemetrics cannot guarantee that devices will work unless we have tested them.) Currently, Kinemetrics supplies SanDisk ATA compatible flash drives, operating over the industrial temperature range in a variety of sizes.

Note: Do not use PCMCIA hard disks in the Makalu or K2s with internal EpiSensors. Their spin-up and seeking will get into the ADC data or produce vibration noise in EpiSensors.

There are both pros and cons to using flash cards and/or hard drives. Please contact Kinemetrics for more information in order to make the best choice for your situation.

Before using any new media, make sure it is properly formatted. To do this, place the new media in an available PCMCIA slot on the K2 and use the Terminal window FORMAT command. Then try to read the device in the PC you plan to use, to make sure that computer can read the card. If your PC cannot read the card, you should get the latest release of the PCMCIA drivers and try these. Kinemetrics' web site contains links to help you find the latest drivers.

As a final option, it is possible to format the card in your laptop and see if the K2 can write to the card. The possible problem with this option is that the format used may not be optimal, and the cards — particularly hard drives — might not be able to keep up when recording 12 channels at 250 samples per second.

如果想更换或扩容 PCMCIA 卡，请与 Kinemetrics 公司联系，可以得到当前最新的存储介质型号以及它的容量一览表。我们也将给你一份你可以自己购买的支持存储介质的清单（Kinemetrics 公司不能保证你购买的存储介质能够工作，除非我们试用过这些介质）。当然，Kinemetrics 公司也提供 SanDisk ATA 兼容闪存驱动器，它有多种型号规格，并且对工作环境温度的要求很低。

注释：在内置传感器的 K2 或 Makalu 记录仪中，不要使用 PCMCIA 硬盘驱动器。因为它们旋转和寻迹的动作会干扰 ADC 数据，同时其振动也增大了记录数据中的噪声。

使用闪存记录器和 PCMCIA 硬盘各有利弊，请与 Kinemetrics 公司联系以获得更多的信息帮助你选取一种最适合于你的记录手段。

使用任何一种新的记录介质，都要进行适当的格式化处理。可以这样做，把新介质插入 K2 记录仪的 PCMCIA 插槽内，从终端窗口输入 Format 命令，然后尝试在你使用的 PC 机上去读该驱动器，要保证你的 PC 机能读这个卡。否则你或许应设法得到最新发行的 PCMCIA 驱动程序，再重新试验。链接 Kinemetrics 公司的网站可以帮助你寻找最新版的驱动程序。

作为最后的选择，可以将这个卡放到你的计算机上进行格式化，然后看看 K2 能否在这个卡上写入文件。如果不能，可能的问题是：所用的格式化程序也许不是最新版本，或者在记录高速传输的数据流时该卡不能保存数据——特别是用硬盘驱动的 PCMCIA 卡更易出现这种问题。

Caution: Possible data loss. If you format the cards in your laptop, are running 6 or more channels, and/or the streaming data protocol, the card may not keep up with the data rate and data could be lost.

告诫：可能丢失数据：如果在你的计算机上格式化 PCMCIA 卡，在运行 6 通道或更多通道，以及/或者运行数据流协议，这个卡可能因为不能以记录仪输出的数据率保存数据而导致数据丢失。

Cleaning the Recorder 清洁记录器

Disconnect all power from the recorder before cleaning it. Then wipe off the exterior surfaces with a mild detergent and a damp soft cloth. 首先断开所有电源，然后用柔软的（低碳的）清洁剂擦拭外壳和表面，再用潮湿的软布擦干。

Caution: Possible water damage. Do not use water to clean the inside of the recorder. Doing so will severely damage the unit!

告诫：防止进水。不能用水清洁记录仪内部，否则有损坏仪器之虞。

If you see dust or debris inside the recorder, we recommend you use a small "computer vacuum cleaner" to remove this debris. Make sure you have turned the power off and that no metallic parts can short between the two battery terminals or from the positive lead to the unit's case. 如果你看到记录仪内部有灰尘或碎杂物，建议你用一个小型的“计算机真空除尘器”来清除这些碎杂物。但要记着关掉记录仪电源并且别用金属物短路电池的两个极板，还要注意，拔下来的正极电源线不能碰上机器底板和仪器盒。

Troubleshooting & Service 故障排除和服务

If your recorder needs repair or service, we generally recommend that you return it to Kinometrics. If you wish to diagnose hardware problems yourself, we provide some cautions below.

The procedure for loading new firmware into the unit is also detailed below. 假如你的记录器需要修理和服务，通常我们建议你发往 Kinometrics

厂家。若你真想自己诊断某硬件问题，我们提出如下注意事项：

往仪器盒中装配新固件的流程也在这里详述。

Hardware Problems 硬件问题

Caution: Only a qualified electronic technician should diagnose and repair the recorder. Be sure the technician carefully follows both the ESD precautions and the precautions described in the *Safety* section.

告诫：只有具有电气技术资格的专业人员才能检查与维修仪器，而技术人员也要仔细遵循本手册前面的提示以及在 *安全须知* 中的忠告。

Do not attempt to repair the unit at the board level unless you have equipment for re-working surface mount printed circuit boards and have gone through the appropriate Kinometrics training course.

We recommend that you stop your diagnosis at the board level and send the entire unit back to Kinometrics for repair.

除非你有恢复印刷电路板到正常工作的水平或所受过 Kinometrics 公司专门技术训练，你别试图修理记录仪的组件。

我们仍建议你停止寻找组件故障的努力而将仪器送回厂家修理。

Installing New Firmware 安装新的固件

Kinematics constantly increases the quality and versatility of its instruments. When we develop new versions of K2 firmware we generally make them available either as a set of firmware disks (available on request), or for downloading from our FTP site.

Note: The K2 is delivered with the latest firmware installed. You only need to load new firmware to upgrade the unit.

Kinematics 公司不断地提高仪器质量并将拓宽仪器的用途。通常我们将更新了或升级了的固件在网站上发布或者作为固件磁盘的套件（应用户要求而提供）而使它们发挥作用。

注：K2 是用最新版本的固件安装的。你从网站下载的软件只需释放到仪器中即可。

Caution: Before loading the firmware program, read the following procedure and the instructions that come with the firmware release. *Use only the instructions that accompany the firmware release.* Also be sure you have the correct versions of all programs.

If you have the wrong program version when you start the installation process, the recorder will not work until the right code is loaded. You can use the firmware selection matrix on Kinematics' web site to determine which version of software you require.

告诫：释放固件程序之前，阅读下述的说明和安装方法（随同固件释放过程就显示出来了）。仅仅用于随同固件释放的指令。你一定要有正确合法的全套程序。如果你有错误的版本，当你开始安装时，记录仪在发现正确代码以前将不能进行覆盖旧版本的工作。在 Kinematics 公司的网站上你可以选择所需要的固件下载。

Note: Before loading firmware, write down all the parameters currently loaded into the unit. Once the new firmware is loaded, reconfigure these parameters exactly as they were. You cannot necessarily reuse an old parameter file because firmware releases often add new parameters. Incorrect parameters can cause the recorder to function improperly.

注：在释放软件时，记下当前释放进记录仪的所有参数。一旦新固件释放完毕，重新配置这些参数（要和记录下来的参数完全相同）。你一定不能使用旧的参数文件（parameter file），因

为释放的固件通常增加了一些新参数。错误的参数能引起记录仪功能紊乱。

Caution: Be sure the internal battery is fully charged and that the power remains constant and steady before beginning the firmware replacement. Any interruptions or major fluctuations in the power supply could cause the recorder to lose its flash memory contents and disable it from reloading new firmware. If this happens, you may have to return the unit to Kinometrics for repair.

告诫：在进行固件置换之前一定要把电池充满电并且使电池电压保持稳定。任何形式的断电或较大的电压波动都会引起记录仪丢失闪存存储器的信息并禁止重新调用新固件。若发生这种情况，则只能请你将仪器发回厂家。

Once you have read the whole procedure to ensure that you have an understanding of the entire process, come back and follow the instructions below step-by-step.

Normally, you will only need to install the new application block. Changes to the Boot Loader rarely occur, but will be considerably more complex than the generic procedure described here.

如果你读过全部过程并且明白了所有操作流程，就可以按下列的步骤做。

正常情况下，你只需要安装那一个新的应用固件块。程序自动在“根加载器（Boot Loader）”上改变很少出现的、但又比通常在这里描述的过程复杂得多的参数。

1. Insert the firmware disk into the appropriate drive in your PC. We recommend that you copy the files from the floppy disk to a directory on your hard drive. This will allow the download to go faster. If you downloaded the file via FTP, find those files on your hard drive. 将固件程序盘插入你的 PC 机的驱动器里，我们建议你将在软盘的程序拷入硬盘的一个子目录中，它会加快下载软件的速度。如果你是借助于 FTP 下载的软件，就可以在你的硬盘上找到那些文件。
2. Use Notepad (or another text editor) to read the new firmware disk's Readme file, as well as any accompanying documentation. 就像看任何其它软件的说明一样，用 Notepad 文本编辑工具（或其它任何文本编辑器软件）读新固件的说明文件 Readme。

Caution: If the documentation that accompanies the firmware differs from the procedure described here, follow the new documentation supplied with the firmware update.

告诫：如果随固件提供的说明文件和这里叙述的不同，就用新的固件程序中的相应文件去刷新那个说明文件。

3. Start QuickTalk and open the Terminal window. (Or, use any terminal program that supports the XMODEM CRC transfer protocol). 启动 QuickTalk，再打开终端窗口（或者使用支持 XMODEM CRC 传输协议的任何终端窗口）。

Note: It is possible to reload firmware remotely to a recorder equipped with a modem or communication device. In this case, the K2 must be reset remotely using the **SYSTEM LOAD** command (not the **SYSTEM RESET** command, which is used for local firmware reloading).

注：使用遥测系统：通过一个 Modem 或通讯设备给远程记录仪加载固件可能也行。这时应该使用 **SYSTEM LOAD** 命令遥控 Etna 使之重新启动，而不能用 **SYSTEM RESET** 命令，因为后者仅适用于在记录仪近端直接给它加载固件。

4. Reset the recorder in one of the following ways:

- Use the **SYSTEM RESET** command
- Flip the *OPER/STBY* toggle switch
- Use the **SYSTEM LOAD** command to load firmware remotely via an internal PCMCIA modem. See *Altus Monitor Mode Communications*, Document 302219 for details on the use of the **SYSTEM LOAD** command.

After the header appears, a series of dots (".....") displays at the bottom of the screen.

4. 用下述方法之一重启记录仪；

使用 **SYSTEM RESET** 命令

关掉 *OPER/STBY* 开关再重新打开到 *OPER* 档

通过一个内置 PCMCIA Modem 使用 **SYSTEM LOAD** 命令遥控记录仪，使它加载固件。参阅 Altus 监控模式通讯（文件号 302219）有关 **SYSTEM LOAD** 命令详细介绍。

当加载固件过程开始时，在屏幕上先出现头段信息，再出现一连串的点（“.....”）。

5. Press the **SPACE BAR**. The Boot Loader main menu will appear, looking something like the list below:

Boot Loader Menu Commands

<A> Install new Application program
 Install new Boot Loader program
 <E> EEPROM diagnostics
 <P> Parameter block erase
 <S> Set new baud rate
 <Q> Quit and perform system reset
 <X> Exit and restart Boot Loader without system reset

Enter Command [A,B,E,S,Q]???:

Note: As of application code version 2.88, the Application and DSP blocks have been combined into one. The Boot Loader no longer provides the option of separately loading the DSP block.

If you need to reload the Boot Loader program, follow the steps below.
 If you do not need to reload the Boot Loader, proceed to Step 10.

5. 敲空格键，则加载引导程序主菜单出现，按如下定义可选择一些

项目查看：

Boot Loader Menu Commands(加载引导程序主菜单命令)

- A 安装新的应用程序
- B 安装新的加载引导程序
- E EEPROM 诊断（诊断电子可擦写存储器）
- P 删除参数块
- S 设置新的波特率
- Q 退出并且重新启动系统
- X 退出并且重新引导加载，但系统不重新启动

从上述定义的选项中，选择 A、B、E、S、Q 命令选项之一。即键入命令选项 [A, B, E, S, Q].

注：从 2.88 版的应用程序开始，已经将应用程序和 DSP（数字台站）块结合在一起了。所以引导加载过程中不再提供单独的加载 DSP 块的软件。

如果你需要重新做一遍引导加载程序可依下面叙述操作，如不需要，直接跳到第 10 步。

Caution: When loading the Boot Loader, follow all instructions exactly. This is a critical process, where power must be maintained at all times.

告诫：重新启动的过程有非常严格的要求，下述步骤必须遵守，并且整个重新启动的过程中不能断电。

6. Enter **B** to load the new Boot Loader and enter **Y** to confirm the selection. *CCC...* displays on the next available line. This indicates that the Boot Loader is ready to receive new code. **You have just under 40 seconds to start loading the firmware:**

Select **Transfer** and **XMODEM Send** from the menu at the top of the screen (or use the appropriate command for your communication program).

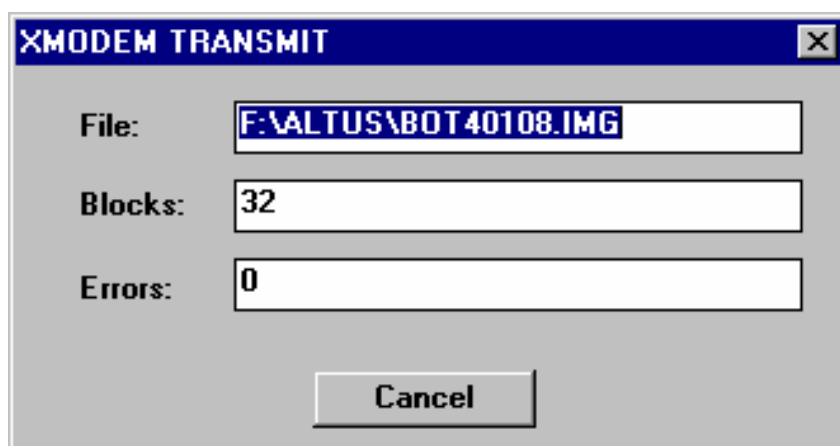
When the Window File menu appears, select the application program's correct path and name from the disk. The filename format is *bot#####.img* (beginning with *bot*, then five numbers, then an *.img* extension).

6. 键入字母 **B** 以启动新的加载引导程序，键入字母 **Y** 以确定选项，这时在其下一行显示 *CCC...*。它表示引导加载过程已经准备好了，正在等待接收一个新代码。你要在 **40 秒以内**开始加载固件（程序）：

从屏幕顶部的菜单中选择传输（**Transfer**）和 **XMODEM Send**（发送）。或使用一条适合于你的通讯程序的传输命令。

当窗口文件（**Windows File**）菜单出现时，选择已经存在于硬盘上的应用程序正确的路径和文件名。这文件名的格式是 *bot#####.img*（用 *bot* 开头，后面是 5 个数字，扩展名是 *.img*）。

7. Double-click on this filename to transfer the Boot Loader program and click on **OK** to begin the uploading sequence. 双击这个文件名，则开始传输引导加载程序了。再回答 **OK**（单击）就自动按顺序加载了。
8. If you complete Steps 6 and 7 within the 40-second time period, the next screen will appear. 如果你在 40 秒钟内完成了第 6、7 步，就出现下一个屏幕。



While the file is loading, observe the XMODEM TRANSMIT screen. The number in the "Blocks" header should increase. 在文件加载过程中，要观察 XMODEM TRANSMIT (XMODEM 传输) 菜单。如图中的 Blocks 字段处显示的数字应该是逐渐增加的。

Note: It is *not* a problem if the number in the "Errors" header increases. This means that XMODEM has had to retransmit a block of data. This happens often. *Windows message will appear if a real problem occurs.*

If the XMODEM TRANSMIT screen *does not* appear (as shown above), then you were not quick enough. You must go back to Step 6 and repeat the procedure.

If the XMODEM TRANSMIT screen *does* appear, go to Step 9. After the Boot Loader has uploaded successfully, the recorder will redisplay the Boot Loader's main menu (shown in Step 5).

注：如果图中的 Errors (错误) 字段处的数字也在增加，这不是问题。它意味着 XMODEM 收到了一块重复传输过来的数据，这种重复传输的情况是经常发生的。假如真发生一个错误，信息窗 (Windows message) 就会出现提示。

如果上图所示的窗口不出现，那就得返回第 6 步去，重新进行第 6 步以后的各种操作过程。

如果上图所示窗口出现了，进行第 9 步。等加载文件顺利完成之后，记录仪将重新显示引导加载的 (Boot Loader's) 主菜单 (如第 5 步中的图示)。

9. After you have completed loading the new Boot Loader, enter **X** to restart the Boot Loader. The new Boot Loader will start and its menu will reappear. 如果你已经完成引导加载过程，键入 X，这时将重

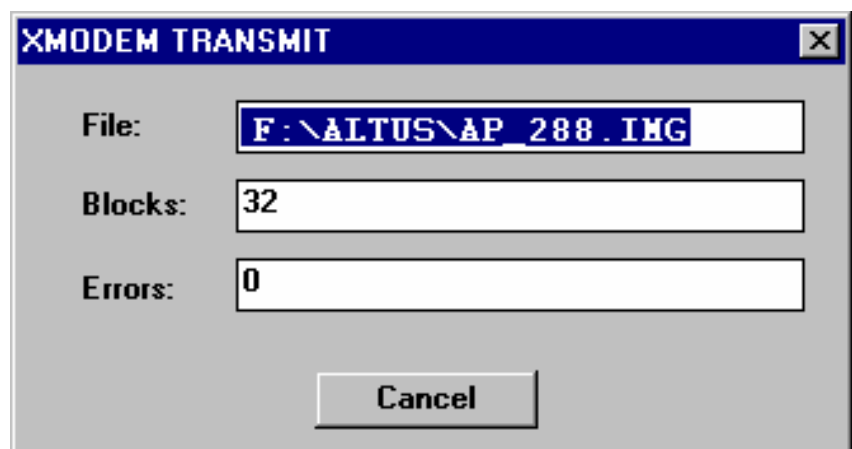
新引导程序，新的加载引导过程将开始并再一次出现引导加载的主菜单。

10. To load the new Application firmware, select **A** from the Boot Loader Menu and enter **Y** to confirm the selection. *CCC...* displays on the next available line. This indicates that the Boot Loader is ready to receive new code. You have just less than 40 seconds to start loading the firmware: 要加载新的应用程序时，在引导加载的菜单中，选择 **A**，点击 **Y** 去确认这个选项。则在其下一行里将显示 *CCC...* 提示。它表示引导加载过程已经准备好了，正在等待接受一个新代码。你要在 40 秒以内开始加载固件（程序）：

Select **Transfer** and **XMODEM Send** from the menu at the top of the screen (or use the appropriate command for your communication program). 从屏幕顶部的菜单中选择**传输 (Transfer)** 和 **XMODEM Send (发送)**。或使用一条适合于你的通讯程序的传输命令。

When the Window File menu appears, select the application program's correct path and name from the disk. The filename format is: *ap#####.img* (beginning with *ap*, then six characters, either numbers or letters with an underscore, and an *.img* extension). 当窗口文件 (Windows File) 菜单出现时，正确指定已经存在于硬盘上的应用程序的路径和文件名。这文件名的格式是 *ap#####.img* (用 *ap* 开头，后面是 6 个符号，这些符号是下划线、数字或字母，文件的扩展名是 *.img*)。

11. Double-click on this filename to transfer the application program and click on **OK** to begin the uploading sequence. 双击这个文件名，则开始传输该应用程序了。再回答 **OK** (单击) 就自动按顺序开始执行了。
12. If you complete Steps 10 and 11 within the given 40-second time period, the next screen will appear. 如果你在 40 秒钟内完成了第 10、11 步，就出现下一个屏幕 (见下图)。



While the file is loading, observe the XMODEM TRANSMIT screen. The number in the "Blocks" header should increase 在应用程序的传输过程中，观察上图的 XMODEM TRANSMIT (XMODEM 传输) 显示。其中的 Blocks 字段处显示的数字应该是逐渐增加的。

Note: It is *not* a problem if the number in the "Errors" header increases. This means that XMODEM has had to retransmit a block of data. This happens often. *Windows message will appear if a real problem occurs.*

If the XMODEM TRANSMIT screen *does not* appear (as mentioned in Step 12), then you were not quick enough. You must go back to Step 10 and repeat the procedure.

If the XMODEM TRANSMIT screen *does* appear, go to Step 13. After the Application block has uploaded successfully, the recorder will redisplay the Boot Loader's main menu (shown in Step 5).

注：如果图中的 Errors (错误) 字段处的数字也在增加，这不是问题。它意味着 XMODEM 收到了一块重复传输过来的数据，这种重复传输的情况是经常发生的。假如真发生一个错误，信息窗 (Windows message) 就会出现提示。

如果上图所示的窗口不出现，那就得返回第 10 步去，重新进行第 10 步以后的各种操作过程。

如果上图所示窗口出现了，进行第 13 步。等应用程序块加载成功之后，记录仪将重新显示引导加载的 (Boot Loader's) 主菜单 (如第 5 步中的图示)。

13. After you have completed loading the firmware, enter **Q** to quit the Boot Loader. The recorder will reset itself. Allow the Boot Loader to start the new Application code.

After loading the new Application firmware into the recorder, enter the *DEFAULT* command in the Terminal window.

Re-configure the instrument with the parameters you wrote down at the beginning of this procedure with the QuickTalk Parameter Editor. This ensures that the parameter file is correct.

Do not reload an old parameter file into the recorder. The update may not function correctly using old information due to possible header format changes.

13. 在你完成加载固件之后，键入 **Q** 退出引导加载过程。这时记录仪自行重新启动，引导加载器得以使用新的应用程序启动记录仪。

在把新的固件加载到记录仪中之后，在终端窗口键入
DEFAULT命令。

按你开始上述这一系列操作之前在 QuickTalk 参数编辑器中重新配置仪器。这时要保证参数文件是正确的。

不要在记录仪上加载旧的参数文件。由于使用旧文件可能会改变头段信息的格式，以致影响仪器的功能。

Decommissioning & Recycling 退役及回收再利用



We can suggest a couple of uses and methods for recycling your recorder:

- Give it to a local school or educational establishment where it can be used to teach earthquake engineering and monitoring.
- Contact Kinemetrics to see if others may have a use for the equipment.
- Disassemble the unit, and then recycle as many components as possible.

If you decide to disassemble the unit, proceed as follows:

1. Remove the battery from the unit and send it to a recycling center.
2. Remove the circuit board card retainer and all the plug-in circuit boards.
3. Disassemble the power supply shield by undoing all the bolts and studs.
4. Remove the GPS shield and receiver from the power supply shield.
5. Remove the power supply board and unscrew the motherboard from the base of the recorder.
6. Remove the front panel by undoing the nuts on the connectors. Remove any other connectors in the case or the lid.
7. Remove the EpiSensor deck from the case, then remove the sensor modules from the aluminum plate and discard them.
8. Turn the recorder over and remove the black anodized aluminum base plate from the unit.
9. Remove the stainless steel hardware from the outside of the case, along with the black nylon latches that hold the cover on the unit.
10. Separate the unit into separate material types, as listed below:

Aluminum: Base plate, EpiSensor deck plate and deck cover, EpiSensor support columns, power supply shield, heat sink blocks, GPS shield, card retainer.

Stainless Steel: Leveling feet, front handle attachments, rear hinge (only on 12-channel units).

Nylon 66: Black latches.

Lexan (PolyCarbonate): Case and lid coated with conductive paint.

These separate materials can now be sent to a recycling center.

我们能够提供两点建议，一是废旧记录仪的用途，另一个是回收方法。

将记录仪放到某地的学校或其它教育机构，进行地震工程培训或用于监测。

如有其它可以使用这种记录仪的方面，请与 Kinemetrics 公司联系。

分解仪器，然后把它拆为尽可能多的部件。

如果分解仪器、按下述流程：

1. 从仪器盒内拆下电池并将它发往“循环使用回收中心”。
2. 拆下电路板的固定卡和 PCMCIA 板；
3. 拧下所有的螺丝和螺栓等固定零件，拆下金属屏蔽壳；
4. 取下 GPS 的屏蔽层并从金属屏蔽壳上拆下接收器；
5. 拆掉主系统板；
6. 拆下前面板（拧掉固定螺丝）；拆下板上的所有其它连接件；
7. 从仪器盒内拆下 EpiSensor（传感器）控制板，然后从铝板上拆下传感器模块，并且丢弃它们；
8. 把记录仪翻转过来，拆下另一块黑色的铝底板；
9. 从仪器盒子外面拆下不锈钢零件，它是用黑色尼龙插栓固定到记录仪的外壳上的；
10. 继续分解这个仪器到更小的部件：

铝件：基板，EpiSensor 传感器模块底板和盖板，EpiSensor 传感器支撑件，电源供给舱的屏蔽层，散热器块，GPS 屏蔽罩，插卡的固定件。

不锈钢件：调平螺钉，前面板的附件，以及后铰链（此只是在 12 通道仪器上有）。

尼龙 66：黑色锁扣（插栓）。

聚碳酸酯：用导电涂层处理过的仪器盒和仪器盒盖。

现在也可以把这些材料发运到回收中心。

5. Reference 参考资料

Technical Overview 技术总论

This section provides an overview of the technical aspects of the system and is designed to provide a basic understanding of its overall operation. The first section describes how the recorder operates while the second section describes the electrical connections in the recorder that are necessary for producing your own cables or performing advanced installations. 本章提供了本系统技术方面的概述，同时也为了给用户提供有关记录器总体操作的基本理解。第一部分是记录器操作的概述。第二部分介绍了制作电缆或进行高级安装必要的记录器的电气连接。

System Overview 系统综揽

The Altus recorder is a modular system comprised of circuit boards connected to a passive motherboard. The motherboard interconnects the various circuit boards. This design approach allows a minimum of internal wiring in the recorder, and greatly enhances the system's reliability.

The following is a simplified explanation of a recorder equipped with internal or external EpiSensors in its normal event-triggered acquisition mode:

1. The EpiSensor senses ground acceleration in three orthogonal directions and converts the acceleration levels to voltages. The input voltage for the EpiSensor or other sensor (seismometer, pore pressure sensor) is sent to the analog-to-digital converter (ADC). The ADC uses an over-sampled delta sigma converter to convert the analog voltage from the sensor to a digital data stream.
2. The digital data stream is then processed by the DSP chip to both filter the data and provide trigger information. This information is then transmitted to the MCU system controller where the data is stored in the pre-event memory buffer. If the SDS is enabled the data is transmitted through the serial port.

3. Every 1/10 second, the system controller examines the various trigger streams to determine if the system should declare an event. The basic unit of data storage in the recorder is this 1/10-second "frame" of data and time code. If an event is declared, the system controller opens a temporary file in the "\TMP" directory on the primary PCMCIA device, then begins transmitting the data into the file (beginning with the pre-event buffer).
4. When the unit detriggers, the system controller moves the temporary file into the event storage directory. The controller then returns to monitoring the trigger condition.

The above describes the basic operation of all the boards except the power supply board and the front panel board. The power supply board generates the operating and charging power for the system and its batteries, while the front panel provides connections to the unit and the PC display. The functions of all the boards are described in greater detail in the next section.

Most of the circuit boards have a serial EEPROM that contains the circuit board's serial number, assembly drawing number, revision and other data pertaining to the board's manufacturer.

Note: See Appendix B: ID Bus Address Assignments for the EEPROM addresses and an example of using the EEPROM diagnostic command in the terminal window to interrogate one of the serial EEPROM devices.

Altus 记录器是由一些电路板连接到一块无源母板所构成的模块化系统。该母板与各种电路板相互连接。该设计尽量做到使记录器内部接线最少，以最大限度地增强系统的可靠性。

配备了内部或外部传感器的记录器，在正常的事件触发模式中做了简要说明。

1. 传感器在三个相互垂直方向上检测地面加速度，并把加速度强度转换成电压。把传感器或其它传感器（地震检波器，微孔压力计等）输出的电压输送到主系统板的 ADC（模拟数字转换器）上。ADC（模拟数字转换器）是一种将模拟电压转换成数字数据流的“过采样 — 转换器”。
2. 数字数据流是 DSP（数字信号处理）芯片的输出，DSP 对数据信号进行了数字滤波并提供了触发判定信息。这个信息传送到系统控制器中，此处已经将数据贮存在存储缓冲器中。如果达到软件设置的“启动输出”判据，那么数据流就可经串口传送。

3. 每隔 1/10 秒系统控制器检测时刻变化着的触发数据流，以决定是否构成一个事件。记录器中数据存储的基本单位是 1/10 秒数据帧和 UTC 时间码。如果被判定为事件，系统控制器就打开 PCMCIA 驱动器上的“\TMP”目录中的临时文件，再把数据传送到文件中（以“事件前”时间内缓冲器存储的内容为开始）。
4. 当设备触发时，系统控制器把临时文件转存到事件存储目录中。然后，控制器返回到触发监控状态。

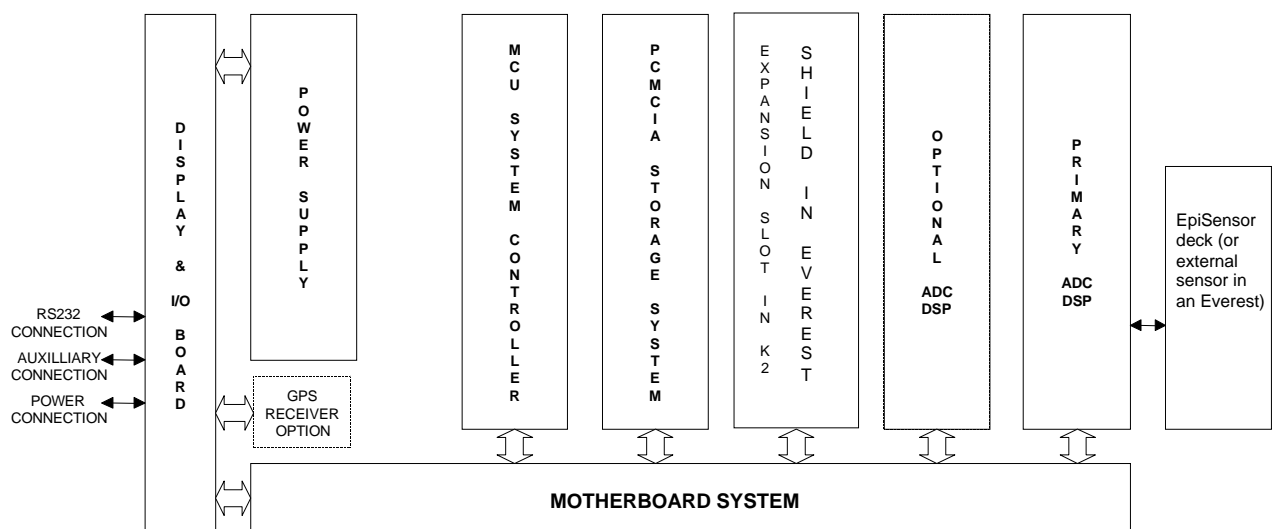
以上叙述了除电源板和前面板外的所有板件的基本操作过程。电源板产生系统运行和其内部电池充电所需的功率，而前面板提供了设备的连接接口和 PC 显示。下节将尽可能地介绍所有这些板件的功能。

大多数电路板有一系列的 EEPROM（电可擦可编程只读存储器），包括属于厂商的电路板系列值、装配绘图值，修订版本号和其它数据。

注意：参看附录 B：为 EEPROM（电可擦可编程只读存储器）的地址分配了 ID 总线地址。使用 EEPROM 诊断命令，可在终端窗口上访问 EEPROM 驱动器之一（见例）。

Figure 26: Block diagram of a recorder

图 26 记录器框图



EpiSensor Deck Theory of Operation

EpiSensor 装置的运行理论

This section describes the operating principles of the EpiSensor. Some options available in the ES-T are not available with the K2's internal EpiSensor deck. Specifically, the internal EpiSensor is not equipped with the low noise option.

The EpiSensor deck consists of three orthogonally mounted force balance accelerometers (FBAs) – X-axis, Y-axis and Z-axis. Each accelerometer module is identical and plugs into a board that provides the final output circuit and the carrier oscillator.

The next figure shows a simplified block diagram of the major components of each of the EpiSensors.

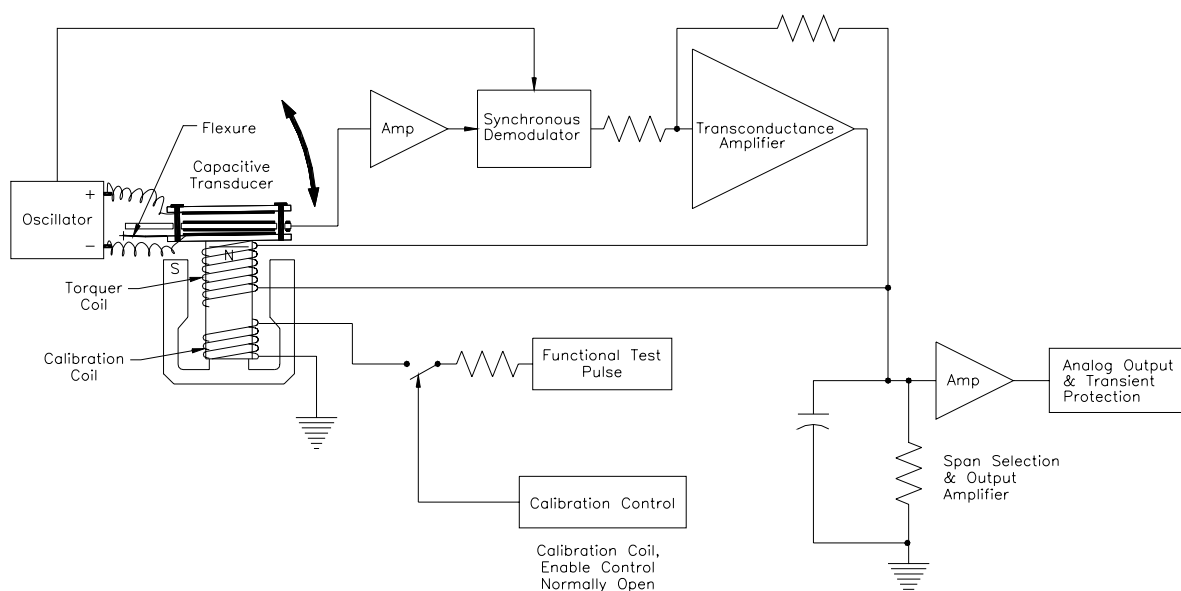
这部分叙述了传感器的工作原理，某些可以在 ES-T 中使用的选项；在 Etna 内部传感器板上不能使用。特别是内部传感器没有安装低噪声选项。

传感器板包括三个正交（X 轴，Y 轴和 Z 轴）安装的力平衡加速度计（FBAS）。每个加速度计的微型组件是相同的，并且插到一个最后输出和载波振荡器的电路板上。

图 27 表明了传感器各主要组件的简化框图。

Figure 27: Simplified block diagram of an accelerometer

图 27 加速度计的简化框图



Working Principle 工作原理

The oscillator applies an AC signal of opposite polarity to the two moving capacitor plates (also referred to as "the moving mass"). When the accelerometer is "zeroed" and when no acceleration is applied, these plates are symmetrical to the fixed central plate and no voltage is generated.

An acceleration causes the coil and capacitive sensor plates, which are a single assembly mounted on mechanical flexures (springs), to move with respect to the fixed central plate of the capacitive transducer.

This displacement results in a signal on the center plate of the capacitor becoming unbalanced, resulting in an AC signal of the same frequency as the oscillator being passed to the amplifier.

The amplifier amplifies this AC signal.

This error signal is then passed to the demodulator where it is synchronously demodulated and filtered, creating a "DC" error term in the feedback amplifier.

The feedback loop compensates for this error signal by passing current through the coil to create a magnetic restoring force to "balance" the capacitor plates back to their original null position.

The current traveling through the coil is thus directly proportional to the applied acceleration. By passing this current through a complex impedance consisting of a resistor and capacitor, it can be converted to a voltage output proportional to acceleration with a bandwidth of approximately 200 Hz.

Selecting a particular resistor value sets the full-scale range. The resistor values are determined by a high accuracy network, so the range can be set at 0.25g, 0.5g, 1g, 2g, and 4g without re-calibrating the sensor span.

The capacitor and overall loop gain are selected along with the resistor to ensure an identical transfer function on each range. *This is why two sets of jumpers must be changed together to modify the range.*

The voltage output of the resistor capacitor network is set at 2.5V for the acceleration value corresponding to the particular range. For example, with the 2g range, a 1g acceleration would cause a 1.25V output, on the 4g range, 1g would result in a 0.625V output.

This voltage is then passed into the low-power amplifier which amplifies the signal by either 1 or 4 (selected by jumpers) to give a single-ended output of either 2.5V or 10V. A precision resistor network also determines this gain value.

振荡器将极性相反的交流信号加到可运动电容器的两个金属板上（有时也称金属板为“运动质量”）。当加速度计是“零”和没有加速度时，这两个金属板相对固定于中心的金属板是对称的，而且没有电压产生。

加速度使单独安装在机械弯曲部分的线圈和电容传感器板运动，运动指电容换能器相对于固定于中心的金属板而言。

这种位移导致电容器中心板信号的产生，电容器系统变成不平衡的，使一个和运动频率相同的交流信号送往放大器上。

放大器放大了这个交流信号。

然后，这个差动信号被传送到解调器进行解调和滤波，在反馈放大中产生一个“直流”残差项。

这个残差项产生流经线圈的电流而产生一个电磁“平衡”恢复力，迫使电容器的极板返回到最初的零位以补偿反馈回路的残差。

电流流经线圈立刻产生和加速度成比例的电压信号，这个电压产生的电流流过由电容器和电阻器组成的复合阻抗中，转换成电压输出。这个电压在大约 200Hz 带宽的范围内与加速度成比例。

选择一个特定的电阻值设置输出的满刻度范围。电阻器的值由高精度网络测定。这样可把满刻度档位设置在 0.25g, 0.5g, 1g, 2g 和 4g，否则重新校准传感器测定范围。

调整电容、总回路增益值与电阻值以确保在每个满刻度档位都具有完全相同的转换功能。这就是为什么在改变满刻度范围时两个跳线的设置必须一起改变的道理。

为了使加速度值与特定的某满刻度档位相对应，电阻、电容网络的输出电压都设置在 2.5V。例如，在 2g 档位，1g 的加速度应当产生 1.25V 的输出；在 4g 档位内，1g 的加速度将产生 0.625V 的输出。

然后这个电压进入低频放大器，通过 1 或 4 倍放大（跳线选择），使末端的输出信号为 2.5V 或 10V。这个增益值（1 或 4）也由精确的电阻网络所确定。

Features of the Internal EpiSensor Deck 内置 EpiSensor 装置特性

CAL COIL 标定线圈

Each EpiSensor module is equipped with a calibration coil. Applying a current to this coil simulates the effect of an acceleration applied to the sensor. This allows a much more thorough check of the sensor's performance than older techniques as a full range of test signals can be applied to the sensor.

The calibration coils are open circuit in normal use to prevent cross talk and noise pick-up. To utilize the calibration coil remotely from outside the unit, the calibration coil enable signal must be activated by applying a DC voltage of +5V to +12V with respect to ground.

A voltage signal applied to the calibration line when the CCE is active will cause all three EpiSensor modules to respond with an acceleration output of approximately 0.05 g per volt applied. The exact calibration coil sensitivity is provided on the data sheet of each module.

This voltage mode is normally used for checking the response of the sensor remotely from a digitizer. If you wish to use a current source to drive the calibration coils in a laboratory setting, they may be accessed by removing the EpiSensor's deck cover. The recorder provides all the necessary controls, signals, and connections to operate the calibration coils on the EpiSensor when it performs a functional test or SRT.

每个传感器组件都配有一个标定线圈。给这个线圈施加电流来模拟施加之传感器的加速度效果。这样就能可以对传感器性能进行更彻底的检查（与过去机械式标定相比），因为测试信号的满量程可以加到传感器上。

在正常的使用中为了防止交越失真和噪声干扰，这个标定线圈是开路的。标定时，通过施加对地+5V ~ +12V 的直流电压，信号能使标定线圈运动。

当通讯控制设备（CCE）运行时，施加于标定线圈的电压信号利用大约 0.05g/V 的加速度输出，引起所有的三个传感器组件的响应。每个组件以数字形式提供了标定线圈确切的灵敏度。

这种电压模式用来自动检查传感器的响应。如要你希望在实验室设置中使用电流源驱动标定线圈，揭开传感器板的盖子就可以连接标定线圈。为了获得更多的信息，请阅读高级安装部分。

EEPROM 电可擦可编程只读存储器

The EpiSensor deck has a serial EEPROM that contains each sensor's serial number and calibration data. This data can be loaded into the unit's parameter menu by typing **DEF FAC** at the Edit Prompt in Terminal Mode.

Note: Since it is possible to accidentally alter this data, be cautious about entering the sensor parameters for an internal EpiSensor deck.

传感器板有一个串口 EEPROM, 它装有每个传感器的串口号和标定数据。在终端模式的编辑提示符下输入 DEF FAC, 厂家设置的默认值就能调入设备的参数菜单。

注意: 意外地改变数据是可能的, 所以对一个内部传感器板输入传感器参数时要谨慎。

Pole Zero Representation of the EpiSensor EipSensor 的极零表达

EpiSensor accelerometers are closed-loop, force-feedback sensors measuring the relative displacement of a moving mass (plates) with respect to the sensor case. The sensor's transfer function (TF) depends almost entirely on the electronic components rather than on the mechanical components of the sensors. The influence on the transfer function of the mechanical damping, spring elements and internal RC low-pass filter in the trans-conductance amplifier stage within the closed-loop path of the sensor are negligible for most applications.

We have determined a good empirical model of the system, which uses two pairs of conjugate poles to represent the transfer function of the instrument. If this transfer function is corrected for the DC sensitivity of the sensor, the amplitude agreement is within ± 0.5 dB over the bandwidth of the sensor. The phase agreement is within $\pm 2.5^\circ$ in the 0-100 Hz band and within $\pm 5^\circ$ over the full bandwidth of the instrument. The phase response of the transfer function is fairly linear and equivalent to approximately 1.6 ms group delay for signals up to 200 Hz. This model can be represented as:

$$\frac{V(s)}{A(s)} = \frac{k1 * k2}{(s - p_1)(s - p_2)(s - p_3)(s - p_4)}$$

where $k1 = 2.46 \times 10^{13}$

$k2$ = Sensitivity of sensor in V/g

s is the Laplace transform variable

$p_1 = -981 + 1009i$ (Pole 1)

$p_2 = -981 - 1009i$ (Pole 2)

$$p_3 = -3290 + 1263i \text{ (Pole 3)}$$

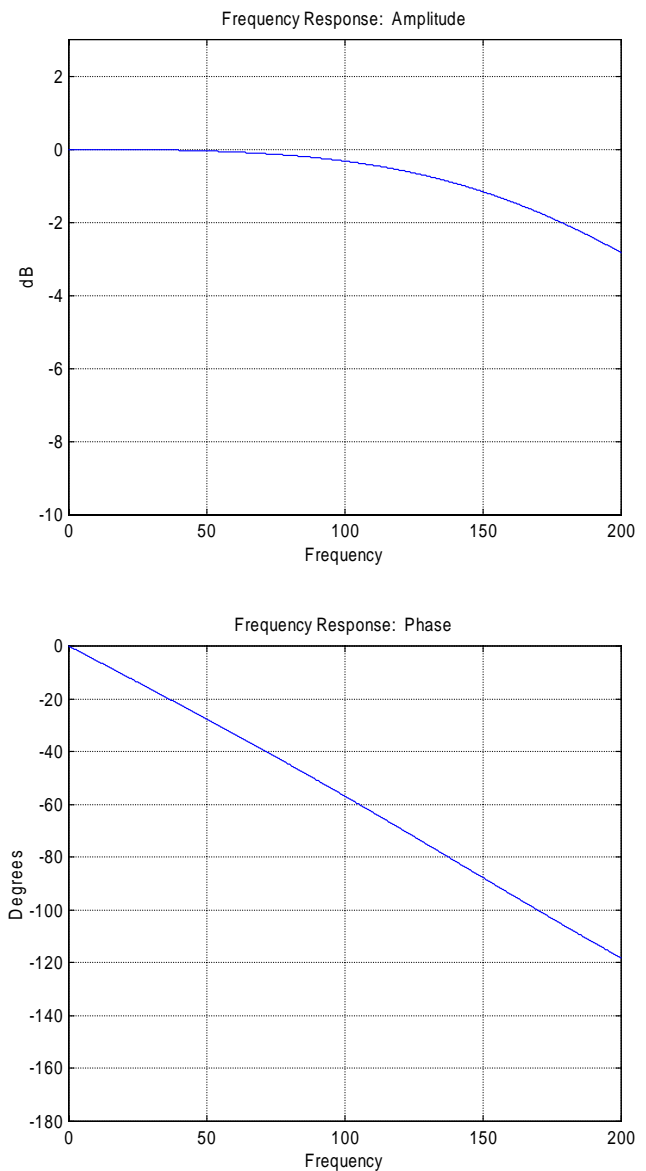
$$p_4 = -3290 - 1263i \text{ (Pole 4)}$$

$V(s)$ is the Laplace transform of the output voltage

$A(s)$ is the Laplace transform of the input acceleration

The figure below shows the amplitude, phase and step response of this pole zero representation. Additional references to pole zero responses and damping are available on the Kinometrics website. Application Note 39 gives the response of the FIR filters used in the recorder's DSP. The FIR filter response dominates the overall instrument response at sample rates up to 250 samples per second.

加速度传感器是锁相环回路的力反馈传感器，测量与传感器有关的质量的相对位移。传感器的传输性能（TF）几乎完全依靠电子组



件，而并非依靠传感器的机械组件。机械阻尼、弹性组件和内部 RC 低通滤波器（位于传感器锁相环回路中的传输—传导放大级中）对传输性能的影响在大多数情况下是微不足道的。

我们已确定了系统良好的实验模式，此实验模式使用两对同源电极表示仪器的传输性能。如果传输性能由传感器的 DC 灵敏度来校正，放大器的工作频段能符合传感器带宽 0.5dB 的要求，在 0—100Hz 频带内相位差小于 2.5° ，在超过仪器满带之外较宽范围内相位差小于 5° 。传输功能的相位响应是完全线性的，并且信号达到 200Hz 时大约有 1.6ms 的群延迟滞后。这个模式可用下式表示：

$$\frac{V(s)}{A(s)} = \frac{K_1 * K_2}{(s - P_1)(s - P_2)(s - P_3)(s - P_4)}$$

其中 $K_1 = 2.46 \times 10^{13}$

K_2 = 传感器的灵敏度 (V/g)

S 是 Laplace(拉普拉斯)变换变量

$P_1 = -981 + 1009i$ (极点 1)

$P_2 = -981 - 1009i$ (极点 2)

$P_3 = -3290 + 1263i$ (极点 3)

$P_4 = -3290 - 1263i$ (极点 4)

$V(s)$ 是输出电压的 Laplace 变换

$A(s)$ 是输入加速度的 Laplace 变换

图 28 表示放大、相位和零极点表征的阶跃响应。横轴为频率 (Hz)，纵轴为 dB 和度。另外有关极点和阻尼的附加参考，可以在本公司的网站上找到。补充说明第 39 条是关于用于 ETNA 仪器上的 DSP 中的傅立叶滤波器的说明。此滤波器可以支持采样率为 250sps 的工作状态。

Figure 28: Amplitude, phase, and step response

图 28 振幅、相位频响

Polarity Conventions 极性约定

Unlike previous generations of Kinometrics force balance accelerometers, the internal EpiSensor deck uses a right-handed X-Y-Z coordinate system with a positive output for acceleration along each axis.

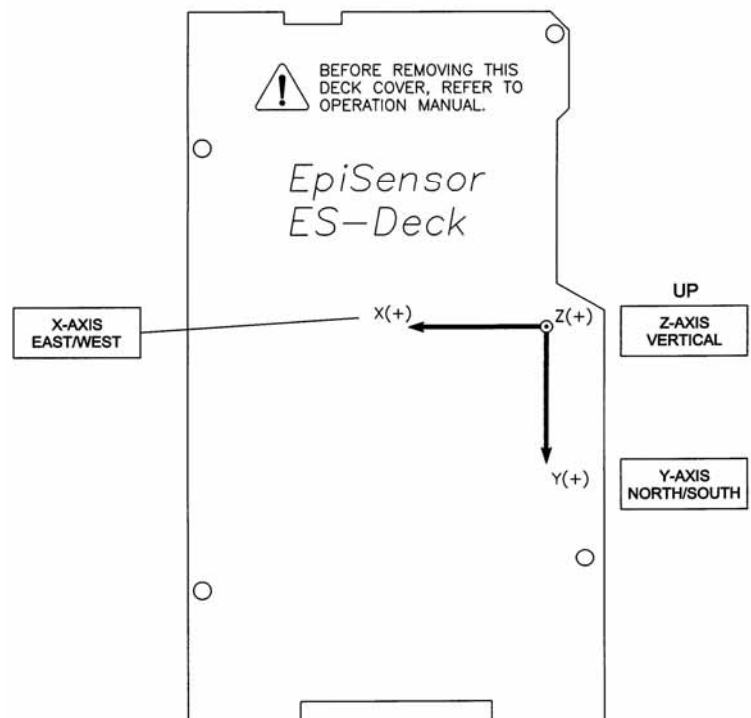
Previous Kinometrics FBA designs used an alternate coordinate system (L, V, T) and produced a negative output for positive acceleration along each axis. With modern feedback sensors, this convention dating from the days of passive seismic sensors is losing acceptance and this simpler convention is more useful.

Kinometrics 力平衡加速度计不同于前一代设备，为了加速度沿每个轴具有正的输出，内部传感器板使用右手 X-Y-Z 坐标系。

早期的 Kinometrics FBA 设计使用交替坐标系 (L, V, T)，沿每个轴正向的加速度产生一个负的输出。现代反馈传感器的使用淘汰了无源地震传感器，而建立的这种简单的规范更加适用。

Figure 29: X, Y and Z coordinates

图 29 X、Y 和 Z 的坐标方位



External Sensors 外接传感器

An optional external sensor I/O board (and connector) for additional sensors may be added to the recorder. The board contains dual stage transient protection and EMI/RFI filtering to prevent electrical transients from damaging

the recorder and to prevent EMI emissions from the recorder or EMI/RFI from degrading the instrument's performance.

The optional external sensor I/O board connects the recorder to external sensors through a military-style circular connector.

The transient protection consists of a primary gas arrestor element followed by a series-impedance and a shunt Transgard® element. This protection circuitry limits the input signals to $\pm 14\text{V}$ with respect to the recorder's ground connection and a maximum ± 26 normal mode voltage between input pairs.

A "T" filter element composed of ferrite beads and a shunt capacitor provides the EMI/RFI protection.

The board also contains an ID EEPROM to store its serial number, assembly drawing and revision number.

可选的外部传感器输入/输出 (I/O) 板和连接器，可将外加的传感器

联到记录器。该板包括双级瞬态保护和电磁干扰/射频干扰

(EMI/RFI) 滤波器，可以防止电子瞬态脉冲对记录器的破坏并避免电磁干扰 (EMI) 或射频干扰 (RFI) 对记录仪的影响，以免降低仪器的性能。

可选外部传感器，将其输入/输出 (I/O) 端经由带电缆的军用式转接器可以连接到记录仪。

瞬态保护由串联阻抗组件、气体避雷器组件构成的电路构成，保护电路将输入信号限制到 $\pm 14\text{V}$ (相对于记录器的地)，而在对称输入时将正常输入电压限制在 $\pm 26\text{V}$ 。

“ T ” 形滤波器由铁氧体圆环构成，旁路分流电容器提供 EMI/RFI (电磁干扰/射频干扰) 保护。

这个板也包括 ID EEPROM (标识符电可擦可编程只读存储器)，以存储它的系列号、汇编图和版本数。

K2 ADC/DSP Board K2 模数转换/数字信号处理板

The internal EpiSensor sends signals to the ADC/DSP board, which performs an analog-to-digital conversion and filters the data stream for the required output rate. There are several versions of the ADC/DSP board for the recorder.

内置传感器将信号传送到主系统板上的模—数转换/数字信号处理 (ADC/DSP) 子系统，实施模拟/数字转换和对输出所需速率的数据流进行滤波。对于记录器有几种版本 ADC/DSP 板。

Two ADC/DSP boards (P/N 109425 and P/N 109440-01) provide four (4) channels of conversion, while the P/N 109440-02 board provides six (6) channels of conversion on a single card. 两个 ADC/DSP 板 (P/N 109425 和 P/N 109440-01) 提供 4 通道的转换, 而 P/N 109440-02 板则提供 6 通道的转换在一个信号卡上。

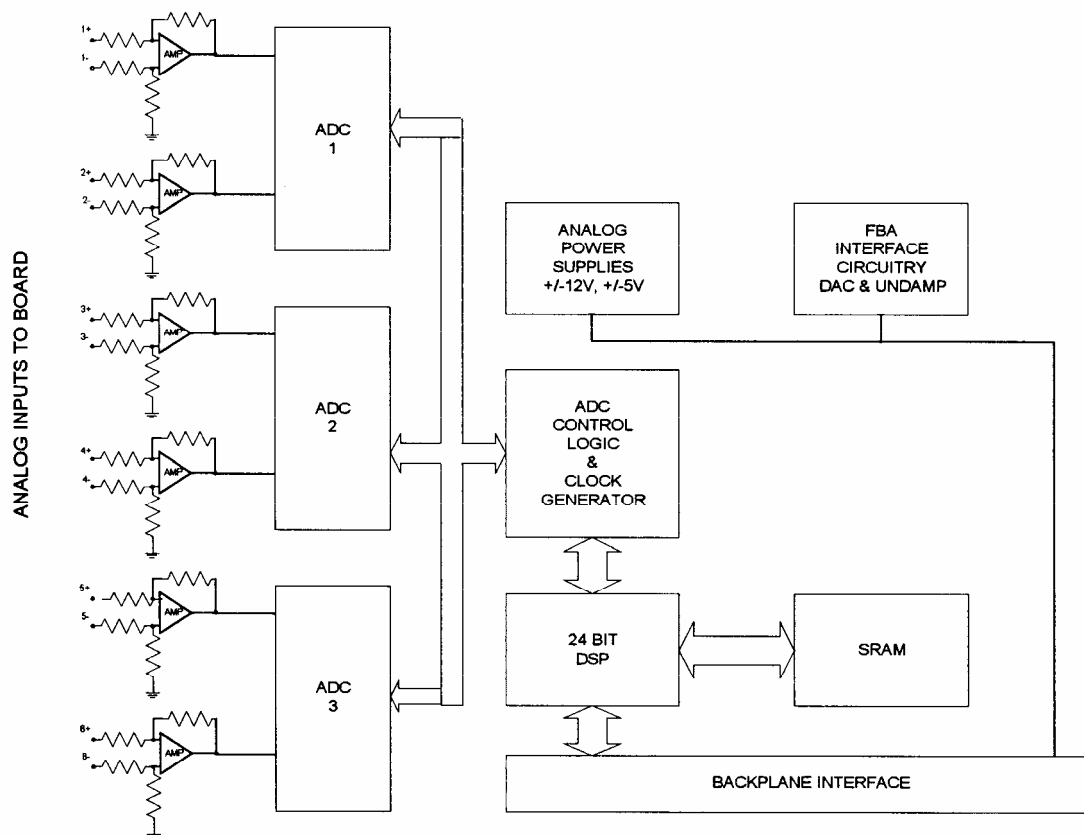
The first two (P/N 109425 and P/N 109440-01) are functionally equivalent. The third (P/N 109440-02) adds an additional dual-channel converter for Channels 5 and 6. 前两个板 (P/N 109425 和 P/N 109440-01) 功能相当。第三块板(P/N 109440-02)加了一个用于 5 和 6 通道的附加双通道转换器。

Figure 30: Block diagram K2 ADC/DSP board (P/N 109440)

图 30 K2 的 ADC/DSP 板的框图(P/N 109440)

ANALOG SIGNAL CONDITIONING 模拟信号状况

For each channel, the analog signal passes through a signal-conditioning amplifier, then through a simple, RC-analog, anti-alias filter, with a single pole at approximately 6 kHz. The analog-signal conditioning is configured as a differential amplifier. This provides approximately 40 dB of common-mode rejection. 对于每一个信道, 模拟信号都通过调节放大器, 再经过单端 RC 模拟、去假滤波器 (大约 6kHz)。为模拟信号调节配置了不同的放大器, 提供大约 40dB 的共模抑制比。



Note: We provided this common-mode rejection (CMR) to ensure good system grounding. However, the system is *not* designed to provide the very high common-mode rejection offered by a true instrumentation amplifier. The gain board options can be used if extremely high (> 90 dB) CMR is required.

注释：我们提供共模抑制（CNMR）以确使系统接地良好。尽管系统并没有被设计成用一个真实仪器放大器提供非常高的共模抑制能力。如果需要非常高的(> 90 dB) CMR，则可用增益板选件。

This stage was designed to accept high-level input signals and offer an input range of $\pm 2.5\text{V}$ with input impedance of 100 k Ω . The channel-to-channel isolation of the system (crosstalk) is better than 106 dB – which means a full-scale input can be applied to one channel without having any effect on any other channel. This provision allows the instrument to be used with dual-gain systems and different sensors without one channel corrupting the data of the other channel. 这个阶段的设计能接收高达 2.5V 的输入信号，输入阻抗为 100k。系统信道与信道之间的隔离（防止串扰）超过了 106dB。这意味着一个较大信号出现在一个信道时而不至于影响其它任何信道。该措施允许仪器使用双增益系统和不同的传感器而不致使一个通道污染另一个通道的数据。

The inputs on this board are not transient protected. When used with the internal EpiSensor deck, transient protection is not required. Channel 4 has transient protection, when it is routed to the front-panel auxiliary connector. 这个板上的输入没有瞬态保护装置。用内部传感器装置不需要瞬态保护。通道 4 当途经前面板辅助连接器时是有瞬态保护的。

If you use external channels for channels 1-3 of a 4-channel unit, or channels 1-3 or 4-6 of a 6-channel system, the external sensor I/O board (P/N 109498) provides the required transient protection. 如果对于 4 通道仪器的 1-3 通道利用外部输入，该外接传感器输入/输出板（P/N 109498），它能够提供所需的瞬态保护。

Caution: Do not connect external signals to the ADC/DSP board without adequate transient protection, as serious damage to the recorder could result!

告诫！不要将外部信号连接到没有提供充分的瞬态保护的 ADC/DSP 板上，否则将严重损坏记录器。

ANALOG-TO-DIGITAL CONVERSION 模数转换

The signal then passes into the delta sigma converter, which produces a digital output stream at 2,000 samples per second. 此后，信号进入 $\Delta\Sigma$ 转换器，产生一个每秒采样 2000 的数字输出流。

Note: The ADC chip's internal digital filter has already provided over 80 dB of anti-alias protection for signals above the 1000 Hz Nyquist frequency of this raw data stream.

注释：ADC 片的内部数字滤波器已经可对原始数据流超过 1000 Hz 奈奎斯特(Nyquist)频率的信号提供大于 80 dB 的去假保护

DIGITAL-SIGNAL PROCESSOR 数字信号处理器

The data then passes into the 24-bit DSP (digital signal processor) chip that performs the filtering required to produce the final output sample rate. The filters in the DSP chip are designed to provide over 120 dB of anti-alias filtering at the final output rate's Nyquist frequency. 然后数据进入 24 位数字信号处理器 (DSP)，实施要产生最终输出采样速率所需的滤波输出。DSP 中的数字滤波器设计成在末级输出速率的奈奎斯特(Nyquist)频率上能提供大于 120dB 信号的去假频率滤波 (Anti-aliasing filter)。

Note: Such a brickwall filter response is practically impossible to achieve with analog filtering alone, due to the number of poles required and the variability of the analog components.

注释：如此 brickwall 滤波器响应由于需要的滤波级数和模拟分量的易变性，用它单独完成模拟滤波实际上是做不到的。

The DSP sends the filtered and decimated data to the MCU. It also calculates whether a channel is triggered by filtering the data through a trigger filter and using a threshold or STA/LTA trigger. If a channel meets the triggering criteria this information is sent to the MCU. This digital signal processing is explained in greater detail in the *Software Reference* section. DSP 输送已滤波和筛选的数据到 MCU。它也用滤波数据透过触发滤波器和用触发阈值方法或 STA/LTA 触发判别方法计算一个通道是否被触发。如果该通道信号符合触发判据，信息就被传送到 MCU。在软件参考 *Software Reference* 节里较详细地阐述了数字信号处理。

OTHER ADC/DSP FEATURES 其它模数转换/数字信号器特性

The ADC/DSP card also contains two isolated and heavily filtered power converters for supplying power to the EpiSensors and other sensors, as well as to the analog-to-digital converter chips. The board also contains a phase-locked loop oscillator circuit designed to minimize clock "jitter" in the delta sigma converter's digital clock. This technology combined with the use of a multilayer circuit board with guarded traces, accounts for the ADC/DSP board's excellent low-noise performance. ADC/DSP 卡还包含两个分离的和极好滤波的电源转换器，以提供 EpiSensor 和其它传感器的供电电源，以及供电到模数转换器芯片。该板也包含了在 Δ 转换器的时钟里设计为了最小时钟“突跳”的一个锁相循环振荡电路。这种技术与具有保护踪迹的多层电路板联用，提供 ADC/DSP 板的最佳低噪声特性。

The ADC/DSP board also contains a control line for the calibration coil enable signal and a 12-bit DAC to produce a calibration sequence for the EpiSensor.

The board also contains a serial EEPROM that includes the board's serial number, assembly drawing and revision number. ADC/DSP 板也还包含一条提供标定线圈使能信号的控制线和为产生供 EpiSensor 用标定程序的 12-位数模转换器 DAC。此板还包括一个含有板的系列号码、装配图及版本数的串行 EEPROM。

Makalu ADC/DSP Board Makalu 模数转换/数字信号处理板

The Makalu uses a different ADC/DSP board than the K2. Its board offers increased dynamic range. Signals from the input board or boards are fed to one or two 3-channel, 24-bit Makalu ADC/DSP boards. The board performs an analog-to-digital conversion and filters the data stream for the required output rate. There is only one version of the Makalu ADC/DSP board and it has three channels.

For each channel, the analog signal passes through a 4-resistor pseudo-differential amplifier to the 24-bit delta-sigma modulator. The amplifier has a 3dB roll-off at 3kHz increasing to 20dB at about 14kHz. An ideal response shown from a Spice model is shown in the next figure.

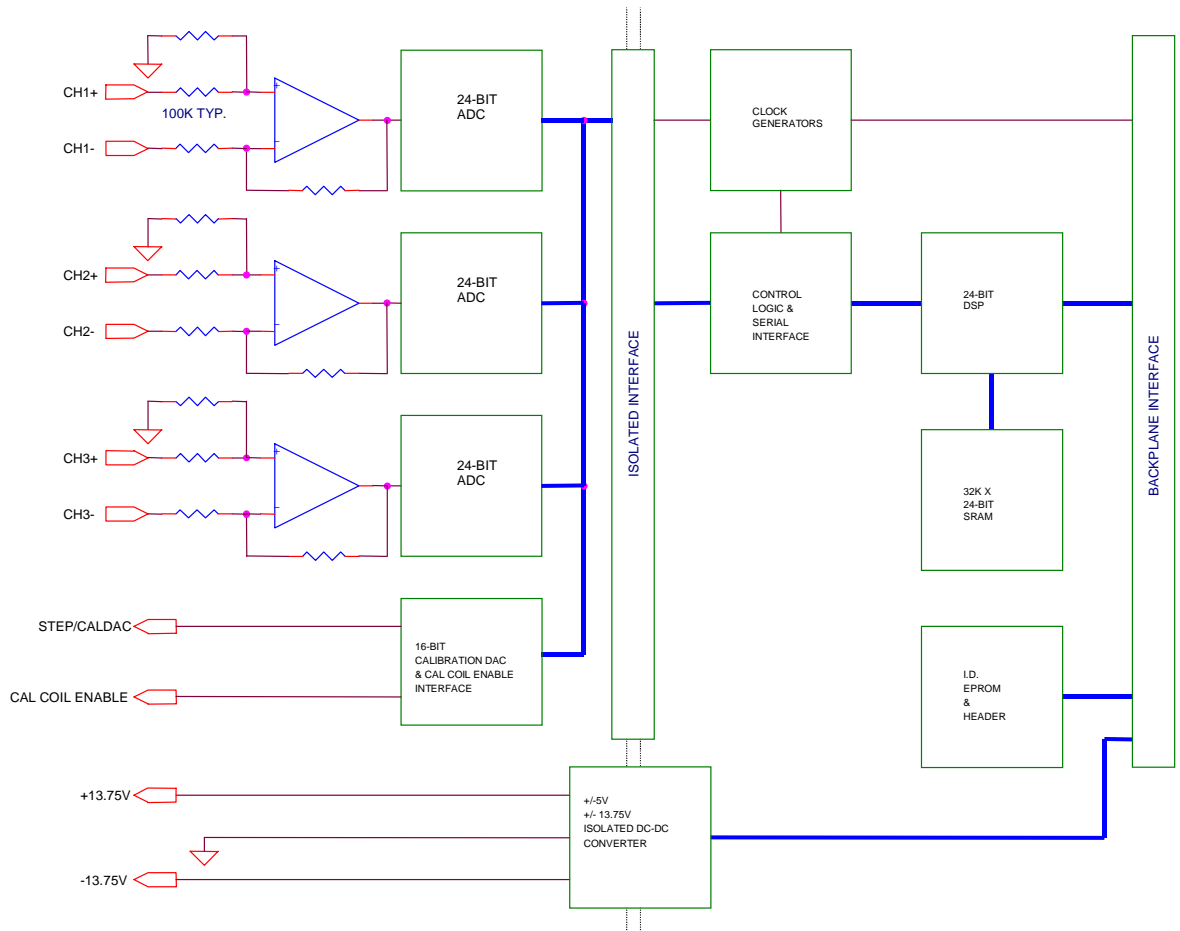
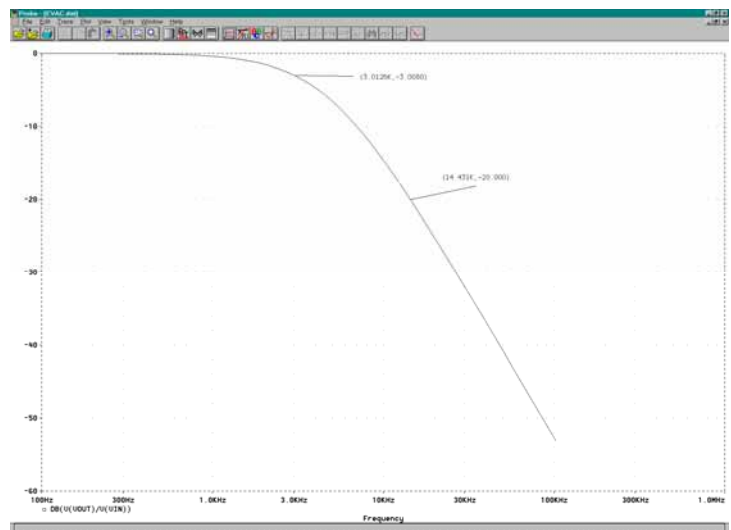
Figure 31: Block diagram of Makalu 24-bit ADC/DSP board (P/N 109590)**图 31 Makalu 24-bit ADC/DSP 板的框图(P/N 109590)****Figure 32: Spice model of Makalu preamplifier response**

图 32 Makalu 前置放大器的 Spice 模型

The common mode rejection ratio of the preamplifier is guaranteed by design to be at least 60dB. This is achieved by the use of extremely well matched precision resistors in the front end.

The input stage is designed to accept the high-voltage input levels of the EpiSensor. Kinometrics has joined with several other sensor and instrument manufacturers in supporting this standard. It is often referred to as $\pm 10V$ differential or 40Vp-p differential.

A +20V differential signal will produce $+2^{23}$ ADC counts and a -20V differential signal will produce -2^{23} ADC counts. The uncompensated full-scale accuracy of the Makalu is around $\pm 1\%$. The DSP performs a scale correction to provide better than $\pm 0.1\%$ accuracy. In actuality, the span error is closer to $\pm 0.01\%$!

The following passage from our design validation report shows the excellent level of crosstalk.

The level of crosstalk was virtually undetectable. The function generator was swept between 1Hz and 50Hz in discrete steps. Additionally, static tests at 10Hz were performed. Driving any two channels at near full scale produced no detectable crosstalk on any non-driven channel.

Caution: Do not connect external signals directly to the Makalu ADC/DSP board without adequate transient protection, as serious damage to the Makalu could result!

ISOLATION BARRIER 隔离屏

All power, clock, control, and data connections between the control logic and the ADCs are 100% galvanically isolated. This includes the power for the preamplifiers and the EpiSensors. This greatly reduces the effects of system-induced noise. It also helps avoid system-level ground loops by allowing the sensor and front end to be tied to the digital and power sections at one and only one point.

ANALOG-TO-DIGITAL CONVERSION 模数转换

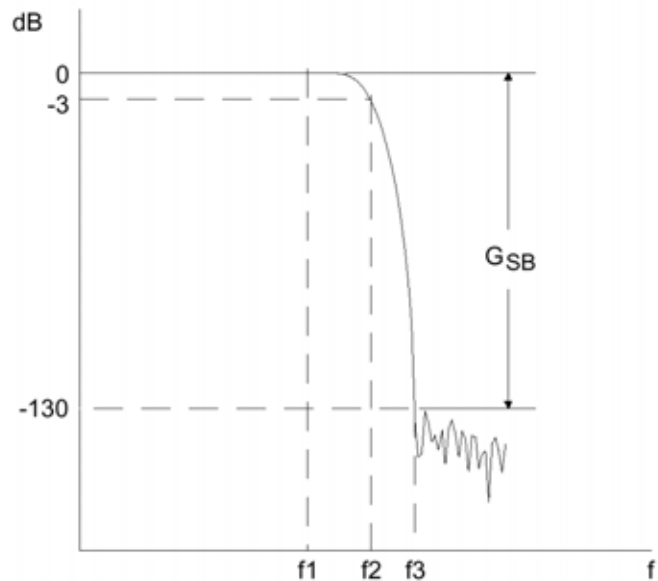
The Makalu ADC/DSP board is based on the Crystal Semiconductor CS5321 and CS5322 24-bit chip set. The digital filter operates at a constant 2000 sps output word rate (OWR). Its response is shown in the figure below (from the Crystal CS5322 data sheet). At 2000 sps OWR, the -3dB point is 824.3Hz.

There are three separate CS5321/22 chipsets, each with its own voltage reference. Each also employs a zeroing switch to ensure that input to the modulator is grounded during its calibration phase at startup.

Figure 33: CS5322 filter response

图 33 CS5322 滤波器响应

Note: 13. $G_{SB} = -130$ dB for all Output Word Rates.



DIGITAL-SIGNAL PROCESSOR 数字信号处理器

Data passes into the 24-bit DSP chip operating at approximately 40MHz, which performs the filtering required to produce the final output sample rate. The filters in the DSP chip are designed to provide over 160 dB of anti-alias filtering at the final output rate Nyquist frequency.

Note: Such a brickwall filter response is practically impossible to achieve with analog filtering alone, due to the number of poles required and the variability of the analog components.

The DSP sends the filtered and decimated data to the MCU. It also calculates whether a channel is triggered by filtering the data through a trigger filter and using a threshold or STA/LTA trigger. If a channel meets the triggering criteria this information is sent to the MCU. This digital signal processing is explained in detail in the *Software Reference* section.

OTHER ADC/DSP FEATURES 其它模数转换/数字信号器特性

The Makalu ADC/DSP card also contains two isolated and heavily filtered power converters to power the EpiSensors and other sensors, as well as the analog-to-digital converter chips. The board also contains a phase-locked loop oscillator circuit designed to minimize clock "jitter" in the delta sigma converter's digital clock. This technology combined with a multilayer circuit board with guarded traces, accounts for the ADC/DSP board's excellent low-noise performance.

The ADC/DSP board also contains a control line for the calibration coil enable signal and a 16-bit DAC to produce a calibration sequence for the EpiSensor.

The ADC/DSP board also contains a serial EEPROM that contains the board's serial number, assembly drawing and revision levels, and its ADC scale correction coefficients.

ADC/DSP Board Jumper Configuration 模数转换/数字信号处理器 跳线设置

109440 K2 ADC/DSP BOARD K2 模数转换/数字信号处理板

Two jumpers are used to configure the board for use as a primary (channels 1-6) or secondary (channels 6-12) ADC/DSP board. The following figure shows jumpers X1, X2, X6, and X5 identified with circles. Each has a 2-mm push-on shunt. 利用两个跳线器设置该板以供作为主 ADC/DSP 板(通道 1-6)或副 ADC/DSP 板(通道 6-12)之用。下图指出跳线器 X1, X2, X6, 及 X5 (以圆圈标记)。每一个跳线器有一个 2 mm 推入式分流跳线。

- Jumper X5 controls the board's base address and IRQ 跳线器 X5 控制板的基地址和 IRQ
- Jumper X6 configures the ID EPROM to respond as device 4 or 12 (primary or secondary respectively) 跳线器 X6 设置 ID EPROM 响应作为装置 4 或 12 (分别主要和次要)

In addition to the above reference jumpers, jumpers X1 and X2 route the channel 4 input from the 3-channel input board or the Auxiliary connector. 另外关于上面涉及的跳线器, 跳线器 X1 和 X2 从 3 通道输入板或辅助连接器安排通道-4 输入。

The shunts are shown as configured for use in the primary position for use in a 6-channel or 12-channel unit. 这些分流跳线被指出设置作为 6 通道或 12 通道仪器中使用在主要的位置。

Figure 34: 109440 K2 ADC/DSP board

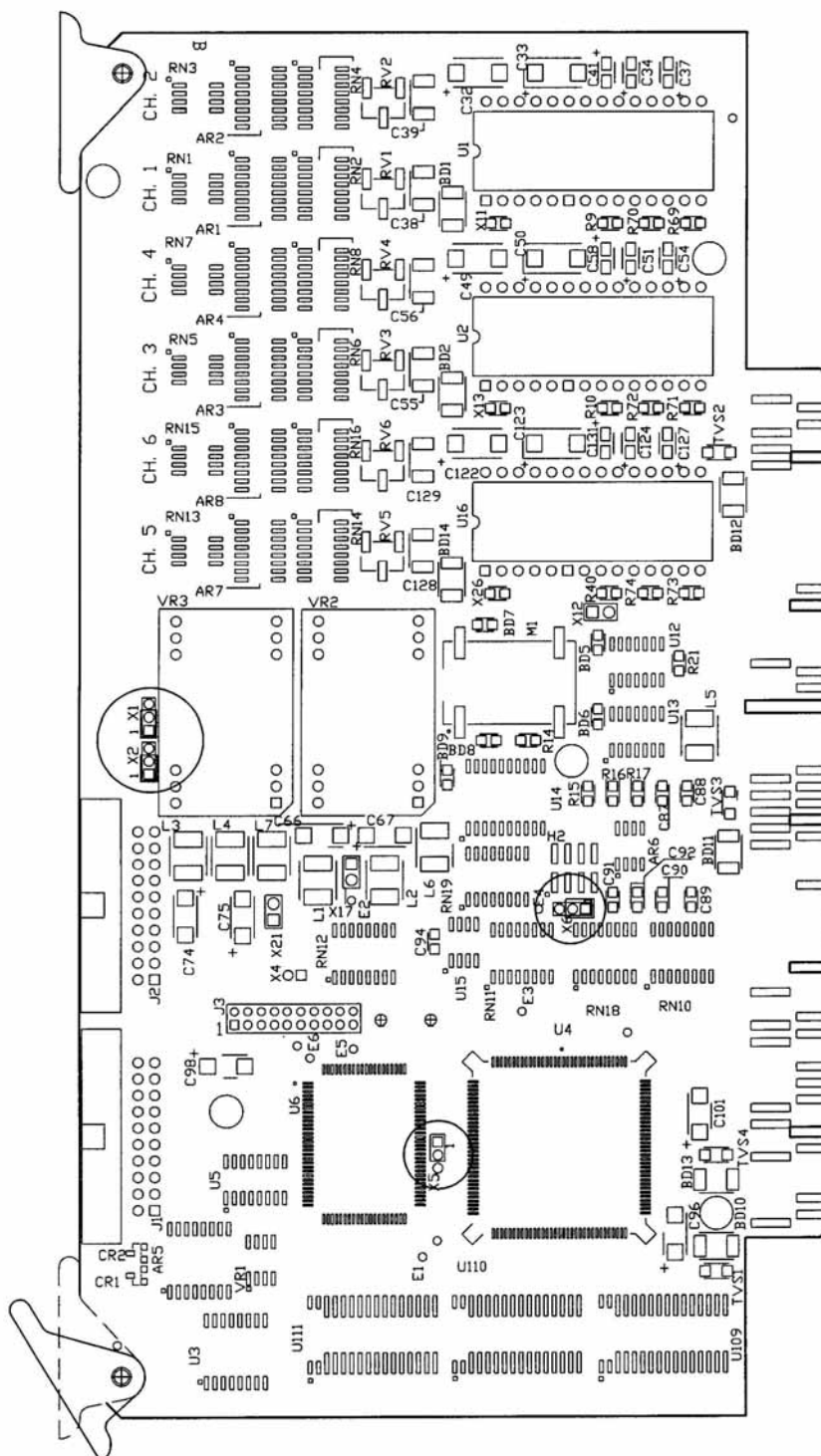


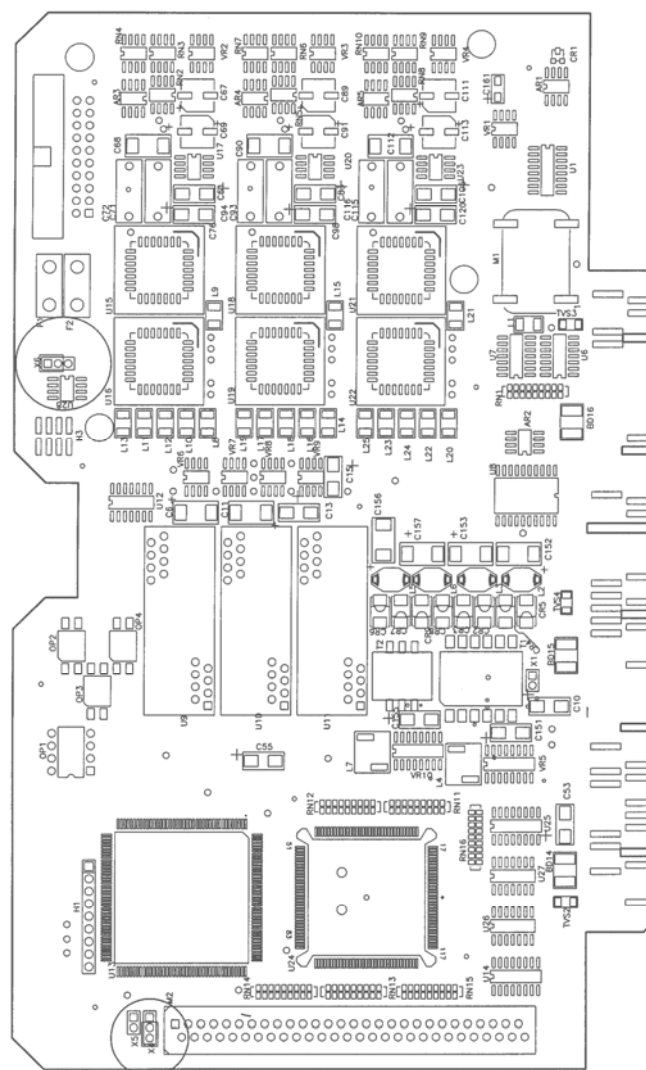
图 34 109440 K2 ADC/DSP 板

109590 MAKALU ADC/DSP BOARD MAKALU 模数转换/数字信号处理板

Like the K2, two jumpers are used to configure the board for use as a primary (channels 1-3) or secondary (channels 4-6) ADC/DSP board. The following figure shows jumpers X4 and X6 identified with circles. Each has a 2-mm push-on shunt.

- Jumper X4 controls the board's base address and IRQ
- Jumper X6 configures the ID EPROM to respond as device 4 or 12 (primary or secondary respectively)

The shunts are shown as configured for use in the primary position.

Figure 35: 109590 Makalu 24-bit ADC/DSP board**图 35 109590 Makalu 24-bit ADC/DSP 板**

MCU System Controller Board MCU 系统控制板

The System Controller Board (MCU, P/N 109445-01, -02) is the "brain" of the recorder. The MCU:系统控制板(MCU, P/N 109445-01, -02)是记录器的“脑”。MCU：

- Determines when to store an event 确定何时存储事件
- Stores the event 存储事件
- Communicates with the user 用户通信
- Transmits the real time communications 传递实时通讯
- Directs the operation of the ADC/DSP card/s 引导 ADC/DSP 协处理器的运行

The MCU system is made up of: MCU 由下列组成：

- A Motorola HC16 microcontroller (16-bit) equipped with 256 kB (in the 109445-01, 512 kB in the 109445-02) of random access memory for pre-event and data storage Motorola HC16 微控制器（16 位），并配备 256KB 的 RAM 以供事件前信息和数据存储
- 512 Kbytes of flash memory to store the system's firmware and parameters 存储系统固件和参数的内存为 512 千字节的存储器（Flash 闪存）
- A sophisticated dual-channel communication chip for the user interface port and the optional network interface 一个复杂的双通道通讯芯片以供用户接口和网络界面选项
- The system's main oscillator and the real time clock 系统主振荡器和实时钟

Figure 36: Block diagram of MCU system controller

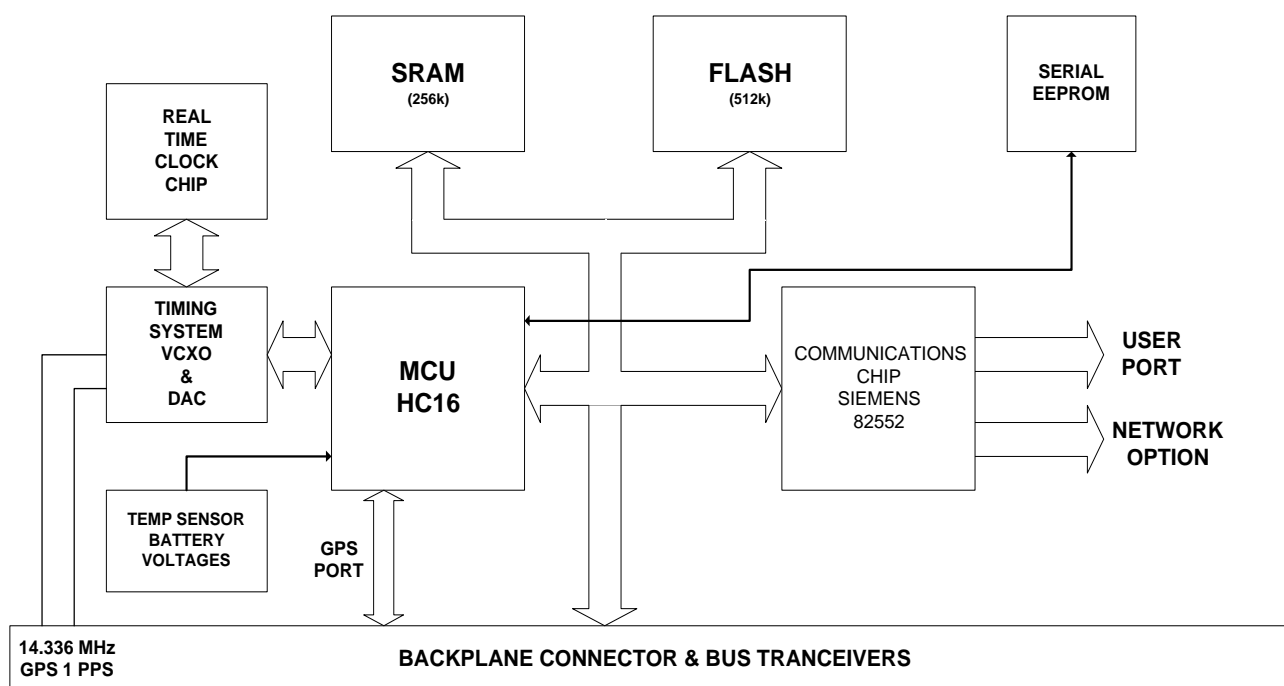


图 36 MCU 系统控制器框图

For communicating with the optional GPS system, the HC16 provides the diagnostic ADC and the GPS serial port, along with a serial EEPROM containing the board's serial number, assembly number, revision, and storage for the system parameters. 为了与 GPS 系统选件通信，HC16 提供了诊断 ADC 和 GPS 串口，与串行 EEPROM 一道控制板的系列号码、装配号码、版本、以及存储系统参数。

FLASH FIRMWARE OPERATION 闪存固件运行

The recorder stores its firmware in flash memory. This allows you to download new firmware through the serial port from either a local PC or over a modem link from a remote PC.

Using a simple boot-loader program, new MCU application programs and DSP application programs can be loaded into the unit. The boot-loader program can also be updated using a somewhat more complicated procedure, which is explained in Chapter 4, *Installing New Firmware*.

记录器将其固件储存在闪烁存储器中。允许下载新的系统固件从当地的 PC 机或者通过 Modem 链接远程 PC 机经串口使固件升级。利用简单的引导装载程序，新的 MCU 应用程序和 DSP 应用程序可将新的固件装载到仪器中。此引导装载程序也可用更复杂一点的步骤予以更新，请参见第 4 章 *Installing New Firmware* 中的说明及 Kinometrics 的

WWW.Kinometrics.com的网址中的介绍。遵照有关新软件的说明来确保特定更新的正确进程。

TIMING SYSTEM OPERATION 时间系统运行

The recorder's time base uses a voltage-controlled oscillator controlled by a 12-bit DAC on the MCU board. In a system without a GPS timing option, this oscillator is factory adjusted to produce a 14.366 MHz clock frequency. This can be re-adjusted in the field by using a high-accuracy counter to measure the 1 PPS output from the recorder, then adjusting the DAC with the DAC command in the Diagnostics Menu. 记录器的时间基准由 MCU 板上的 12 位模数转换器 (DAC) 控制的电压控制振荡器提供。在没有配备 GPS 时间选件的系统中, 这个振荡器给出 14.366MHz 的时钟频率是由厂家调好的。用户在现场可以通过高精度计数器测量来自记录器的 1PPS (脉冲/秒) 输出, 以及通过“诊断菜单”中的 DAC 命令, 微调 DAC。

The variation of this oscillator is approximately ± 50 PPM over the operating temperature range of the recorder. Thus, if you used this oscillator alone to drive the real time clock, there could be a worst-case frequency drift of approximately one-minute per month. The real-time clock can be set using QuickTalk software, covered in the *QuickTalk/QuickLook User's Guide* at the back of this binder. For improved accuracy, a time-synchronization pulse can be applied to the auxiliary connector. 超过记录器的运行温度范围时, 此振荡器的变化大约为 ± 50 PPM。使用振荡器连续驱动实时钟, 能观察到最坏情况下因频率漂移引起的钟差, 大约为每月 1 分钟。能利用 QuickTalk 软件 (参见本手册后面 *QuickTalk/QuickLook User's Guide*) 设置实时钟。为了提高精度, 一个时间同步脉冲可应用于辅助连接器。

Note: In systems using the optional GPS receiver, the GPS system can both synchronize the absolute time and adjust the crystal frequency, providing much improved timing performance. See the GPS manual at the rear of this binder for more information. 在使用了可选 GPS 接收器的系统中, GPS 系统既能实时同步时钟, 也能调整晶体振荡频率, 提高同步性能。Altus *GPS 时间服务系统用户手册* (文件 302205) 中讲述了 GPS 系统的操作。

PCMCIA Board PCMCIA 卡板

The recorder is supplied with two fully compliant PCMCIA cardholders (the mounting positions are known as "slots") that can accept Types I, II, and III PC cards. The cardholders are mounted on the PCMCIA board (P/N 109415) in the recorder. 给记录器提供了两个全适应的 PCMCIA 卡槽, 能插入 I, II, III 型 PC 卡。卡座安装在记录器内的 PCMCIA 板 (P/N 109415) 上。

Note: Firmware supports only a selected number of PCMCIA devices. Contact Kinometrics to find out which devices are supported. 固件仅支持 PCMCIA 设备的选择值。请与 support@Kmi.com 联系。查明能支持哪些设备。

Cardholder B has a parallel connector on the back of the card that will accept a PCMCIA modem or other supported communication device PCMCIA with its output cable. If the rear connector is used this way, you *cannot* install a PCMCIA card in cardholder B — this would conflict with the device installed in the rear connector. 插槽 B 有一个位于卡背面的连接器，供带有输出电缆的 PCMCIA modem 或其它被支持的通信设备使用。如果背面连接器使用这种方法，你就不能在卡座 B 中连接 PCMCIA 卡——这将与背面连接器的设备安装发生冲突。

图 注 插槽 A 插槽 B
 PCMCIA 卡电源控制芯片
 PCMCIA 卡控制器芯片
 PCMCIA 卡 B 至通讯设备的并口插座
 底板插座

Figure 37: Block diagram of PCMCIA board

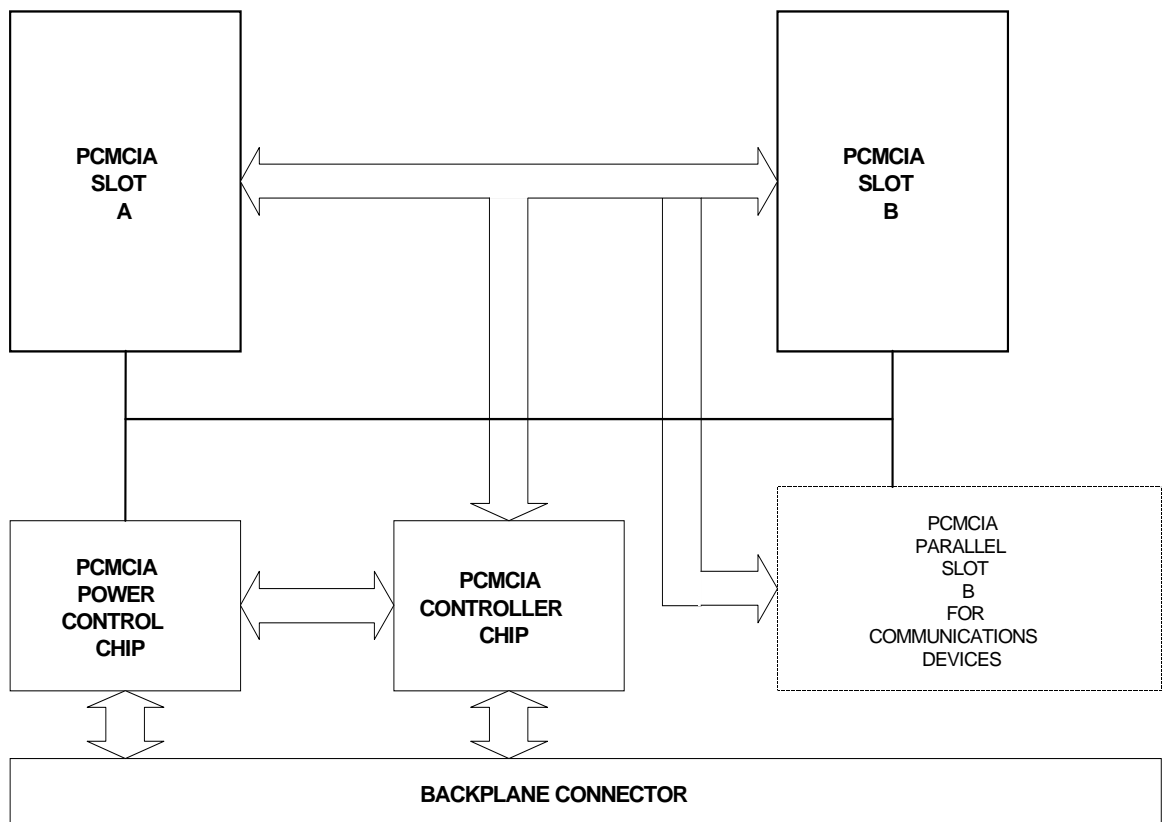


图 37 PCMCIA 板框图

Power Supply Board 电源供应板

The various power supplies and battery charging circuits for the recorder are located on the power supply board. 在电源供应板上(PSB)设置有记录器所用的各类供电电源和电池充电电路。

- For a 4- or 6-channel K2 and an Makalu, use power supply board 109410. 对 4-或 6-通道 K2 和 Makalu , 使用 PSB (P/L09410) 。
- For a 12-channel K2, use power supply board 109615-01. 对 4-或 6-通道 K2 和 Makalu , 使用 PSB (P/L09615-01) 。

The board used in the 12-channel K2 can supply more current and does not generate the 3.3V supply. 该板被用在 12-通道 K2 时能提供更多电流并不产生 3.3V 供电。

The recorder is designed to run off either an: 本记录器被设计为了关闭下列两者之任一：

- Externally connected, nominal 24 VDC charging voltage supplied by the external, wide-input power supply (PSA) option (P/N 109485; CE P/N 109480) and generated from the local AC line, or 外接的, 用外部宽输入供电电源(PSA)选件(P/N 109485; CE P/N 109480)和从市电 AC 线所提供的正常 24 VDC 充电电压, 或
- An externally supplied 12V source such as a battery or solar charging system. 外部 12V 电源诸如电池或太阳能充电系统。

When running from its external power supply, the recorder uses a switching regulator to produce a nominal 13.5 VDC voltage. This voltage supplies power to the recorder while also charging both an internal and external battery (if present). The nominal voltage is temperature compensated to ensure efficient float charging of 12V sealed, lead-acid batteries. 当仪器由外部电源供电运行时, 记录器用交换调节器产生 13.5 VDC 常规电压。该电压提供电源至记录器, 同时还对内置电池及外部电池 (如有的话) 进行充电。为确保对 12V 密封铅酸电池进行有效的浮充电, 该常规电压是被温度补偿的。

The system provides two independent charging circuits for both the internal and external batteries. Each charging circuit has a pulsed, current-limit circuit that protects the recorder from a shorted or reversed battery. It will recharge a flat battery by supplying short pulses of current to restore the battery's charge without overloading the power supply's capacity. 该系统提供两个为内置和外接电池两者的独立充电电路。每个充电电路都有脉冲电流限制电路以在电池短路及反极时保护记录器。它将用提供短电流脉冲再给一个扁平电池充电一恢复该电池的充电能力而不致使电源供电容量过载。

Note: If AC power fails, the batteries should supply power to the recorder. If AC power is not available, use a float-charged external battery as the recorder's sole source of power, deriving the float charge from a solar

power system made up of a solar cell and a solar voltage-regulator system.

注释： 若 AC 电源失效，这些电池应该提供记录器供电。若不能获得 AC 电源，则可用一个可浮充电的外接电池作为记录器的唯一电源，用太阳能电池和太阳能电压调节器系统组成的太阳能供电系统对其进行浮充电。

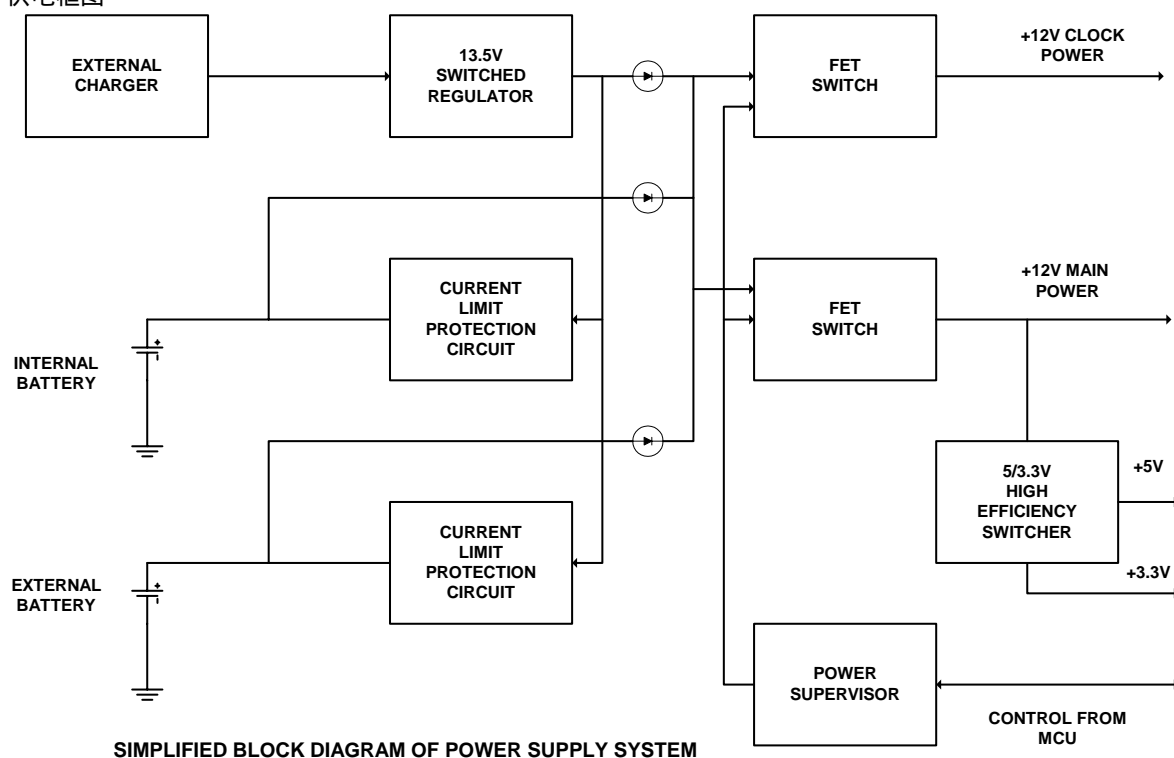
The power supply contains a power supervisor chip that shuts the main system down when the voltage from the batteries drops below 10.6V. The chip will then cut the power to the timing circuitry when the voltage falls below 10V. This feature prevents damaging deep discharge to the system's batteries. 此供电装置包含一个电源管理器芯片，它在电池电压下降到 10.6V 以下时，可使主系统关闭。此芯片当电压下降到 10V 以下时切断时间电路供电。此特性保护系统电池免受太过放电的危险。

The MCU can also command the power supply to cut the main system power when it senses the power-switch state has changed from *Operate* to *Standby*. Further, when the supervisor senses the voltage has fallen below the 10.6V operating threshold, it alerts the MCU which then commands the power to shutoff. This feature allows the unit to power down in an orderly manner and closes any open files. MCU 还能在它感知到电池开关状态由 *Operate* 到 *Standby* 改变时命令供电装置切断主系统供电。进而，在此电源管理器感知电压以降落到 10.6V 运行阈值以下时，它警告 MCU 命令电源关闭。

When A/C power is restored, the system will automatically return to full operation once the battery voltage reaches approximately 11V. When the main power is switched on, it drives a high-efficiency, synchronous-switching regulator that generates the 5V power for the recorder's logic — as well as a 3.3V power supply. 在恢复 A/C 供电后，一旦电池电压补充到 11V 时，此系统将自动地恢复到全运行状态。此时，主电源打开，它驱动一个高效同步开关调节器使记录器逻辑电路产生 5V 电源—以及一个 3.3V 供电电源。

Figure 38: Block diagram of power supply

图 38 供电框图



Front Panel Board 前面板

The front panel of the recorder provides the standard connections for power, RS-232 interface, and auxiliary I/O. The front panel also contains the 8-LED display and the line drivers for the I/O connections. The system fuses are located at the top of the front panel, as are the battery connections. The front panel also contains the connectors used to connect the optional GPS receiver to the system.

A network of Ferrite beads, capacitors and Transgard devices protect the recorder's inputs against EMI/RFI and ESD; additional gas-arrestor protection provides transient protection for the power supply input and the Channel 4 ADC input.

记录器前面板上有外部电源和 RS—232 及辅助 I/O（输入/输出）标准接口。该前面板也包括 8 个发光二极管指示灯和作为 I/O 连接器。系统和电池连接的熔断丝位于前面板的顶部。前面板还包含用以连接 GPS 接收器选件的连接器。

由铁氧体磁珠、电容器及 Transgard 装置组成的网路保护记录器的输入防止电磁干扰/射频干扰（EMI/RFI）和静电放电（ESD）；附加气体-抑制器保护提供了供电输入和通道-4 输入的瞬变保护。

System Power Requirements 系统电源功率需求

The exact current drawn by the recorder depends on the exact options contained in your system.

Use the K2 or Makalu tables below to calculate the approximate current draw of your system from the 12V supply. This can be used to calculate the autonomy of the system and to correctly "size" a solar charging system. The values in the tables are inflated slightly to ensure that the expected battery autonomy is achieved.

流过记录器的确切电流依赖于系统中的具体选件。

利用下列 K2 或 Makalu 表格 6、7，计算由 12V 电源供电时系统耗电的大约值。据此能计算出系统自身的电流并帮助估算太阳能充电系统的容量。表格中的值被略微抬高了，这是考虑了电池自身性能的差异。

Table 6: K2 system power requirements

表 6 K2 系统功率需要

	Option Current 耗电 /mA	Number In Your System	Subtotal Current
Recorder without ADC cards 无 ADC 卡的记录器	190		
4-channel ADC card 4-通道 ADC 卡	190		
6-channel primary ADC card 6-通道主 ADC 卡	280		
Secondary 6-channel ADC 6-通道副 ADC 卡	280		
External I/O boards 外接 I/O 板	10		
3-channel gain board 3-通道增益板	10		
Internal EpiSensor deck 内置 EpiSensor 装置	50		
EpiSensor ES-T (standard 标准)	50		
EpiSensor ES-T (low noise 低噪音)	180		
Other sensors 其它传感器(<i>calculate current from single 12V supply using 50% efficiency for power converters</i>)	Customer-supplied value 用户提供值		
GPS system permanently on (5m, 25m antenna) 全 荷 GPS 系统 (5 米、25 米天线)	125		
GPS system 5% duty cycle(5m, 25m antenna) 5%GPS 系统 (5 米、25 米天线)	7		

Extended GPS system permanently on 全荷外接 GPS 系统	225		
Extended GPS system 5% duty cycle 5%外接 GPS 系统	12		
Typical PCMCIA hard drive 典型 PCMCIA 硬驱	150		
PCMCIA modem (<i>max not power controlled</i>) PCMCIA modem (无电源控制的最大值)	110		
		TOTAL 总计	

Table 7: Makalu System power requirements

表 7 Makalu 系统功率需要

	Option Current/mA	Number In Your System	Subtotal Current
Makalu without ADC cards	190		
3-channel primary ADC card	175		
3-channel secondary ADC card	175		
External I/O boards	10		
3-channel gain board	10		
EpiSensor ES-T (standard)	50		
EpiSensor ES-T (low noise)	180		
Other sensors (<i>calculate current from single 12V supply using 50% efficiency for power converters</i>)	Customer-supplied value		
GPS system permanently on (5m, 25m antenna)	125		
GPS system 5% duty cycle (5m, 25m antenna)	7		
Extended GPS system permanently on	225		
Extended GPS system 5% duty cycle	12		
PCMCIA modem (<i>max not power controlled</i>)	110		
		TOTAL	

When you know the current consumption of your system, its actual autonomy with the supplied 12AH battery can be calculated using this formula:

$$T \text{ (hours)} = 12000 \div I \text{ (mA)} = \text{hours of autonomy}$$

An example of a basic 4-channel K2:

$$T \text{ (hours)} = 12000 \div 380 = 31.6 \text{ hours of autonomy}$$

当已知系统总电流消耗时，可以用以下公式计算 12Ah 电池的实际供电时间：

$$T \text{ (小时)} = 12000 \div I \text{ (mA)} = \text{小时}$$

例如：一个通常的 4 信道 K2 记录仪：

$$T \text{ (小时)} = 12000 \div 380 = 31.6 \text{ 小时}$$

EpiSensor Power Consumption EpiSensor 功耗

The EpiSensor current drain values included in the previous table are nominal. To more accurately determine the worst case EpiSensor current requirement, use the information in the following table. These values take the sensor current drain values and correct them for the conversion efficiency of the K2 and Makalu power supplies. 前面表格中的传感器电流消耗值是极小的。为了更精确地测定最坏情况下所需电流，可利用下表中的有关信息。这些数值考虑了 K2 和 Makalu 电源的转换效率而经过修正的电流作为传感器电流的消耗值。

Table 8: EpiSensor static current drain from recorder power supply

表 8 从记录器供电的 EpiSensor 静态电流消耗

EpiSensor ES-T Static Current Drain, All 3 Axes ES-T 传感器耗电 (3 通道总体)	K2	Makalu
Standard post amplifier 标准主放大器	40mA	45mA
Low-noise post amplifier 低噪声主放大器	110mA	130mA

Table 9: EpiSensor dynamic current drain

表 9 EpiSensor 动态电流消耗

EpiSensor ES-T Dynamic Current ES-T 传感器动态电流	K2		Makalu	
	1 Axis 单通道	3 Axes 3 通道	1 Axis	3 Axes
Restoring current for coils per g 复位电流	3.88mA/g	11.63mA/g	4.5mA/g	13.5mA/g
Output amplifier load at $\pm 2.5V$ single-ended or $\pm 5V$ differential full-scale 满刻度负载	1.09mA	3.26mA	1.26mA	3.78mA
Output amplifier load at $\pm 10V$ single-ended 满刻度负载	10.23mA	30.69mA	11.88mA	35.6mA

The HypoSensor's (downhole triaxial EpiSensor accelerometer) current drain is identical to that of the EpiSensor ES-T in the same configuration. Uniaxial EpiSensors (model ES-U) are not offered with the low-noise amplifier. Three EpiSensor ES-U accelerometers will draw essentially the same current as an ES-T configured to use the standard post amplifier. HypoSensor 传感器 (井孔三轴力平衡加速度计) 电流消耗与相同配置下的 ES-T 传感器的电流消耗是相同的。单轴传感器 (ES-U 模式) 没有提供低噪声放大器。为了使用标准的主放大器，三个单信道传感器 (ES-U 加速度计) 的电流消耗，实质上与 1 个 ES-T 的消耗是相同的。

Both the K2 and Makalu recorders can furnish sufficient power for any dual-supply configuration of the EpiSensor. Single-supply versions will require power from another source and should not be powered from the standard K2 or Makalu external three-channel input connector. K2 和 Makalu 记录器两者都

能提供充分电源以为 EpiSensor 的任何双路供电设置。单路供电方式将需从另外的电源供电，而不应从标准 K2 或 Makalu 外接 3-通道输入连接器获得。

Power Supply Adapter Ratings 供电适配器额定值

The CE-rated optional power supply charger is P/N 109480; the standard power supply is P/N 109485. They are rated as follows:

Power supply charger 109485

AC input voltage	90-265 VAC
AC frequency	47-63 Hz
AC current requirement	2.0A (maximum)

Power supply charger 109480



AC input voltage	90-264 VAC
AC frequency	47-63 Hz
AC current requirement	2.0A (maximum)

CE-标称的可选供电充电器是 P/N 109480；标准供电充电器是 P/N 109485；标称值如下：

供电充电器 109485

AC 输入电压	90-265VAC
AC 频率	47-63Hz
AC 电流值	2.0A(最大)

供电充电器 109480

AC 输入电压	90-264VAC
AC 频率	47-63Hz
AC 电流值	2.0A(最大)

Operating Temperature 运行温度

The external operating temperature range for recorders using SanDisk cards depends on the options installed.

4-channel K2	- 20 ⁰ to + 70 ⁰ C
3- or 6-channel Makalu	- 20 ⁰ to + 70 ⁰ C

6-channel K2	- 20 ⁰ to + 65 ⁰ C
12-channel K2	- 20 ⁰ to + 60 ⁰ C

记录器使用 SanDisk 卡外部运行温度视可选件的配置而略有不同。标准 4-通道 K2 和 3-或 6-通道 Makalu 记录仪的正常运行范围是 -20 到 +70 ， 6-通道 K2 是 -20 到 +65 ， 而 12-通道 K2 则是 -20 到 +60 。

For K2s using the optional PCMCIA hard drive, the external operating temperature range should be limited to 0 to + 45⁰ C because the hard drives have a limited operating range. (In practice, if the unit is continuously powered, temperatures of -5⁰ C are probably acceptable as the unit dissipates sufficient power to bring the inside of the unit to 0⁰ C.)

在 K2 内使用可选的 PCMCIA 硬盘驱动器时，外部运行温度应当限制在 0 ~ +45 ，因为硬件驱动器有一个限定的运行范围。（实际上如果给设备连续供电，-5 的环境温度也基本上可以满足工作条件。因为当设备消耗充足的电力时，可使设备内部温度上升到 0 左右）。

Operating Humidity 运行湿度

The case of the recorder is designed to meet the requirements of a NEMA 6P enclosure (equivalent to IP67). The system can operate in humidity levels of up to 100% and withstand occasional temporary immersion in water up to 2 meters in depth. The system should not be continuously immersed, as galvanic corrosion of the connectors will occur, potentially destroying the system. To ensure operation in high humidity, the desiccant packet must be fresh and the case of the unit should be carefully sealed after opening. 记录器的外壳是依据满足 NEMA 6P 机壳附件（和 IP67 相符）的要求设计的。即湿度达到 100%时，系统能够运行，并且能经受住特殊场合临时浸入 2 米的深水中。系统不应持续浸水，因为电化学侵蚀可能腐蚀连接器，有损坏系统的可能性。为了确保能在高湿度中运行，必须及时更换干燥剂。设备的外壳每打开一次，应仔细地进行密封。

Detailed Electrical Interface 电气接口 详述



The standard electrical connectors are divided into seven types. Each type has different voltage/current ratings. When designing your own interface or cables, be sure the signals are compatible to avoid damaging the recorder. The types are listed below:

RS-232C inputs. All inputs are RS-232C compatible, except that, because of the recorder's transient protectors, the maximum input voltage must be limited to less than $\pm 14V$.

RS-232C outputs. The outputs swing $\pm 10\text{V}$ (nominal). They are transient-protected at $\pm 14\text{V}$ like the RS-232C inputs.

Type 1 signal inputs. These inputs are active-low and are designed to be driven by the recorder, other Altus products, SSAs, or similar open-collector outputs (or devices with similar drive characteristics). The input threshold is set at 2.5V and the signal inputs are pulled up to $+5\text{V}$ with $4.7\text{ k}\Omega$ resistors. These inputs are considered "true" when they are pulled below 2.5V . The input hysteresis is approximately 60 mV . These inputs are transient protected. The maximum voltage input must be limited to $\pm 14\text{V}$.

Type 1 signal outputs. These outputs are active-low, open-collector transistors. They are meant to be connected to type-1 signal inputs, SSA inputs, or similar devices. There are no pull-up resistors on these lines. They must be pulled up by the input to which they are connected. The maximum pull-up voltage is $+20\text{V}$. These outputs can "sink" 100 mA at 70°C with a saturation voltage of approximately 170 mV . If these outputs are connected to inductive loads, such as relays, use appropriate spike-suppression diodes. The outputs are transient protected at $\pm 14\text{V}$.

+12 volt power inputs. Used to connect external $+12\text{V}$ power sources to the recorder. They are reverse-voltage and transient-protected. Limit the maximum steady-state voltage to 14V (although the suppressors are rated to conduct only 1 mA at 16V).

+24 volt charger power input. This input is reverse-voltage and dual-stage transient-protected. Limit the maximum steady-state input voltage to less than 26V (although the suppressor is rated to conduct only 1 mA at 29.5V).

Channel 4 analog input and ground. These inputs are dual-stage transient-protected at $\pm 5.5\text{V}$. The input is protected with respect to the ground return and the chassis ground.

标准的电气接口划分为七种类型。每种类型有不同的电压/电流额定值。当设计你自己的接口或电缆时，为了避免损坏记录仪，还应确保信号是兼容的。这些类型列举如下：

RS-232 输入：由于记录器的瞬态保护，除了最大输入电压必须被限制到小于 $\pm 14\text{V}$ 以外，所有的输入都应是和 RS-232C 兼容的。

RS-232 输出：输出电压为 $\pm 10\text{V}$ （额定值）。它们的瞬态保护在 $\pm 14\text{V}$ ，同 RS-232C 的输入口。

1 类信号输入：这些输入是低电平有效的和被设计为本记录器、另外的 Altus 产品、SSA 仪器或类似的开启式集电极输出(或类似驱动特性的装置)所驱动的。设置输入的阈值在 2.5V 并且信号输入在用 $4.7\text{ k}\Omega$ 电阻器时被停止在 $+5\text{V}$ 。这些信号当它们拉在 2.5V 之下时是被认为

“可靠的”。输入滞后大约是 60mV。这些输入是被瞬变保护的。该最大输入电压必须限制在 $\pm 14V$ 。

1 类信号输出：这些输出是低电平有效的、开启式集电极晶体管。这意味着它们是为 1 类信号输入、SSA（状态保存器）输入或类似器件提供输入信号。在这些线路上没有配停止电阻器。和类型 1 信号连接的输入必须具有停止电阻。信号最大的停止允许电压是 20V。这些输出用一个大约 170mV 的饱和电压，在 70 时能“抑制”100mA。如果将输出信号连接到电感负载上，如继电器，那么就需要使用尖峰脉冲抑制二极管，在输出 ± 14 时可以被瞬态保护。

+12V 电源输入：给外部 12V 电源提供的连接到记录器上的接口。它们具有反向电压和瞬态保护功能。应将最大稳态电压限制到 14V（尽管估计干扰抑制器在 16V 时仅产生 1mA 的电流）。

+24V 充电器电源输入：该输入具有反向电压和二级瞬态保护功能。应将最大稳态电压限制到 26V（尽管估计干扰抑制器在 29.5V 时仅产生 1mA 的电流）。

通道 4 模拟输入和接地：这些输入在 $\pm 5.5V$ 是受二级瞬态保护的。具有良好接地回路，输入是受保护的。

Connector Pin Definitions 连接器接脚定义

RS-232C 通信接口

The RS-232C communications port conforms to the DTE standard — except for the use of a circular military-style connector. Except for the pin assignments, the port closely resembles that of a PC COM port.

Users normally connect one of two units to the RS-232C port:

- A PC, using a RS-232C cable
- A modem using a cable

The recorder uses a Maxim MAX248 RS-232C transceiver IC, and operates at baud rates up to 57.6 Kbaud. The serial word format of this port (as well as the digital data stream output) is fixed at 8 data bits, 1 stop bit and no parity. The DSPRXD and DSPTXD digital data stream interface provided on the AUXILIARY connector have identical characteristics. The digital data stream baud rate is determined by the output data rate: 4800, 9600, or 19200 baud.

RS-232C 通信口除符合军用型连接器的使用外还符合 DET (数据终端设备) 标准。除了插头指定外, 插口类似于 PC COM 口。

用户通常可以将下述两个设备之一连接到 RS-232 口：

连接 PC 的 RS-232C 电缆

一个连接 modem 的电缆

记录仪使用一个 Maxim Max248 RS-232C 收发器 IC, 且运行波特速率可达 57.6k 波特。此端口(以及数字数据流输出)的格式为 8 个数据位, 1 个停止位, 没有奇偶校验位。该 DSPRXD 和 DSPTXD 数字数据流接口提供了 AUXILIARY 连接器有完全相同的特性。数据数字流波特率取决于输出数据率: 4800、9600 或 19200 波特。

Table 10: RS-232C pin descriptions

表 10 RS-232 接脚说明

Pin 针序	Name 名称	I/O 输入/输出	Description 描述
A	DCD	RS-232C Input 输入	Data Carrier Detect 数据载波检测
B	CTS	RS-232C Input 输入	Clear to Send 清除并准备发送
C	RTS	RS-232C Output 输出	Request to Send 要求发送
D	DSR	RS-232C Input 输入	Data Set Ready 数据设置准备就绪
E	Ground	---	Ground 地
F	DTR	RS-232C Output 输出	Data Terminal Ready 数据终端准备就绪
G	TXD	RS-232C Output 输出	Transmit Data. (RS-232C output serial data from recorder MCU board.) 传输数据 (从记录器 MCU 板的 RS-232C 口输出串行数据)
H	RXD	RS-232C Input 输入	Receive data. (RS-232C input serial data to recorder MCU board.) 接收数据 (从记录器 MCU 板的 RS-232C 口接收串行数据)
J	Ground	---	Alternate Ground Pin 辅助接地
K	RI	RS-232C Input 输入	Ring Indicator 电话铃声指示器

The mating connector is an FCI P/N 851-06EC12-10SN50; you can also order it as Kinemetrics P/N 851020, along with appropriate Kinemetrics cables to go with the connector; neither cables nor connectors are automatically supplied with the recorder. A complete cable can be ordered from Kinemetrics.



To ensure that the recorder meets the conducted and radiated RF emissions requirements of the European Union, a FerriShield™ (KMI P/N 840734) should be attached to this cable.

相匹配的连接器是 FCI P/N 851-06EC12-10SN50；你也可以订购 Kinemetrics 的 P/N 851020 以及与连接器相匹配的 Kinemetrics 电缆；电缆和连接器都不是自动提供给连接器的。全部的电缆应向 Kinemetrics 订购。

为了确保记录器满足欧共体管理和辐射的射频发射的要求。FerriShield(KMI P/N 840734)应连接到电缆上。

Ext Power 外接电源接口

The recorder's external power connector connects to the battery charger/power module or optional external 12 VDC power source. It also provides for the connection of a 12V standby power source. The battery charger cannot charge the standby power source. 外部电源用来连接所提供的电池充电器/电源模块或其它外部 12VDC 电源选项。它也提供 12V 备用电源的连接。此电池充电器不能提供备用电源的充电。

Table 11: External power connector descriptions

表 11 外接电源连接器说明

Pin 针 序	Name 名 称	I/O 输 入/ 输出	Description 输入/输出
A	+24 VDC	+24V Input 输入	Input from the optional wide-input external battery charger/power module (PSA). This power module automatically operates from 90 to 220 VAC at 50-60 Hz. Its output is 24 VDC at 2 amps. 由可选的宽输入外部电池充电器/电源模块(PSD)输入。该电源模块可自动地运行在 90 到 220 VAC、50-60 Hz 的范围。它的输出为 24 VDC、2 安培。
B	Ground 地	---	One of three power ground pins provided. 3 个电源地线接线针之一。
C	Standby 备 用 +12 VDC	+12V Input 输入	Standby power input from external 12V battery. Unlike pin E, this battery cannot be charged by the recorder itself. This input is intended for short-term connection of +12V to maintain the recorder's time base while the internal (or external) main battery is "changed out" with a fresh one. Do not use it for a permanent connection. 由外部 12V 电池作为备用电源输入。不连接引脚 E，该电池不能由记录器本身提供充电。该输入是打算在记录器内置（或外设）主电池更新时作为该记录器运行所需的 +12V 临时供电连接使用。不能用它作为永久的供电连接。
D	Ground 地	---	One of three power ground pins provided. 3 个电源地线接线针之一。
E	Ext 外部 +12 VDC	+12V Input 输入	Power input from external 12V battery. External sealed lead-acid batteries can be float-charged at 13.5V by the recorder's battery charging circuitry. The recorder's battery charge regulator is currently limited at approximately 600 mA. If the recorder is to be powered by a +12V DC source, connect it to this pin. 电源输入由外部 12V 电池提供。外部密封铅酸电池能够以记录器电池充电电路用 13.5V 进行浮充电。记录器电池充电调节器限制电流约在 600mA。如果记录器是以 +12V DC 电源供电，则可将它接在此引脚。
F	Ground 地	---	One of three power ground pins provided. 3 个电源地线接线针之一。

All inputs are transient-protected. The maximum steady state voltage applied to the +12V inputs must be limited to less than +14V. The voltage applied to the +24V input must be limited to less than +26V. 所有输入都具有瞬态保护。最大稳态电压为+12V 供电输入，且其端电压必须限制小于+14V。

Caution: The inputs are reverse-voltage protected, however, permanent reverse connection to a battery will eventually damage the battery.

告诫：尽管具有反向电压保护，然而持久的反向连接最终将损坏电池。

The mating connector is an FCI P/N 851-06EC10-6SN50 (not supplied with the recorder, but automatically furnished if you purchase Kinometrics' wide-input power supply assembly). The mating connector can be purchased alone, as Kinometrics P/N 851024. 匹配连接器是 FCI P/N 851-06EC10-6SN50 (不随记录器提供，但如果你购买 Kinometrics 公司的宽输入供电装置则随配)。此匹配连接器(Kinometrics P/N 851024)也可单独向 Kinometrics 公司购买。

Auxiliary 辅助接口

The auxiliary I/O connector provides access to the recorder trigger, alarm, timing, digital data stream, and channel-4 sensor input. A +12 VDC output is also provided to furnish power for external accessories. 辅助接口 I/O 连接器提供进行记录器触发、警报、时间服务、数字数据流，以及通道-4 的传感器输入。还提供有+12 VDC 输出可为外加附属设备供电。

Table 12: Auxiliary pin descriptions

Pin 针 序	Name 名称	I/O 输入/ 输出	Description 描 述
A	DSPRXD	RS-232C Input 输入	RS-232C serial data input used for digital data stream interface. RS-232C 串行数据输入用以数字数据流接口。 Refer to <i>Detailed Electrical Interface</i> and Table 11 for more information.
B	ALARMOUT	Type 1 Output 1 类 输出	This line goes low when recorder alarm criteria are exceeded. It is latched until reset with <i>Clear Alarm</i> command. 当记录器警报限值被超越时此线走低。在重置 <i>Clear Alarm</i> 命令前它是被锁住的。
C	IRIGIN	Type 1 Input 1 类输入	Time code input for recording purposes. Compatible with IRIG "E" and "H" formats (sampled at recorder sample rate.) Normally used for time correlation with instruments other than recorders. If positive-logic standard IRIG code is connected to this input, the recorded code will be inverted due to the active-low nature of the recorder inputs. 时间代码输入是为记录目的。适合 IRIG "E"和 "H"格式(以记录采样律作采样)。常规用以对记录器以外的仪器做时间关联。如果正-逻辑标准 IRIG 代码接到此输入，由于记录器输入的实际低电平性质，此记录代码将反转。
D	IRIGOUT	Type 1 Output 1 类 输出	Inverted IRIG "E" (10-second frame) time code generated by recorder. It is used for time correlation with instruments other than recorders. When connected to recorder inputs, recorded code will be positive logic. 反转 IRIG "E" (10-秒帧)时间代码由记录器产生。它是用以对记录器以外的仪器做时间关联。当连接到记录器输入，记录器代码将是正逻辑。
E	TICKSTART	Type 1 Input 1 类输入	This line is used to sync the time-of-year clock in conjunction with the TIME command to an external time mark. The recorder's clock will start on the first positive-to-negative transition of this line.此线被用来与 TIME 时间命令一起对一个外部时间标号使年时钟同步。此记录器的钟将随此线的首次由 + 到 - 的变换而启动。
F	1 PPSOUT/ CPPC	Type 1 Output 1 类 输出	This line provides a once-per-second pulse output from the recorder's time-of-year clock. Negative transitions are "on-time." The duration of the pulse is 200 ms. Alternatively, it can be configured as the cellular phone power control line. 该线从记录器的年时钟提供一个每秒 1 个脉冲的输出。负转换是“按时”。脉冲持时为 200ms。它也能够设置为蜂窝电话电源控制线，两者取一。

G	TRIGIN	Type 1 Input 1 类输入	A low level on this input will trigger the recorder to record an event if the parameters are set accordingly. Recording will continue as long as the line is held low. Once the line is returned to the high state, the post-event will commence. When triggered by this line, recording starts on the next 0.1 second frame but the pre-event memory is adjusted back to the last one second mark. 如果相应地设置参数，一个低电平在此输入上将触发记录器记录一个事件。只要该线保持低电平，记录就将连续下去。当以此线触发，记录在下一个 0.1 秒帧启动，而且事件前存储是被调节回至最后一秒标志。
H	TRIGOUT	Type 1 Output 1 类 输出	This line is asserted when the recorder's trigger criteria are exceeded. It is not held true during the duration of the event. 当记录器的触发阈值被超出时该线被维持。而当事件持续时它无效。
J	CH4INGND	---	Analog ground return for channel 4 input. 4-通道输入的模拟地回路。
K	CH4IN	Analog Input 模拟 输入	Analog input signal to channel 4. Input resistance 100 K Ω . Full scale voltage $\pm 2.5V$. 至通道-4 的 100K 电阻的模拟输入信号。
L	DSPTXD	RS-232C Output 输出	RS-232C serial data output for digital data stream interface. RS-232C 串行数据输出用以数字数据流接口。 Refer to <i>Detailed Electrical Interface</i> and Table 11 for more information.
M	+12VOUT	+12V Output 输出	+12 VDC power for external accessories. Controlled by OPERATE/ STANDBY switch. Current drawn should be limited to less than 100 mA. 为外设供+12 VDC 电源。用 OPERATE/ STANDBY 开关控制。用电流量应限制低于 100mA。
N	Ground 地	---	One of five digital/power ground pins. 5 个数字/功率接地针脚之 1。
P	Ground 地	---	One of five digital/power ground pins. 5 个数字/功率接地针脚之 1。
R	Ground 地	---	One of five digital/power ground pins. 5 个数字/功率接地针脚之 1。
S	Standby 备用 +12VDC	+12V Input 输入	Alternate connection point for applications of standby power. 为使用备用电源的后背联结点 Refer to <i>Detailed Electrical Interface</i> and Table 11 for more information. Do not continuously power the unit through this pin. 切勿用此针脚为仪器提供持续供电
T	Ground 地	---	One of five digital/power ground pins. 5 个数字/功率接地针脚之 1。
U	Ground	---	One of five digital/power ground pins. 5 个数字/功率接地针脚之 1。

表 12 辅助接口接脚说明

The mating connector is an FCI P/N 851-06EC14-18PN50. This connector is supplied with the recorder. You can order additional connectors, as Kinometrics P/N 851022. 匹配连接器是 FCI P/N 851-06EC14-18PN50。此连接器不随记录器提供。你可订购 Kinometrics 公司的此附加连接器 (Kinometrics P/N 851022)。

GPS Antenna GPS 天线接口

When the recorder is equipped with the optional internal GPS, a BNC bulkhead feed-through connector is added to the recorder's case (under the latch on the left side of the case). The supplied antenna is connected to the BNC (see the *Altus GPS Timing System User Guide*). 当记录器配备可选内部 GPS 时，BNC (同轴电缆插件) 防水插头插入记录器的外壳插座上 (在外壳左边

的弹簧锁下)。提供的天线与 BNC 相连接 (见 Altus 记录系统 GPS 时间系统用户手册, 文档 302205)。

External Sensor Input 外接传感器输入接口

The optional external sensor I/O board connects the recorder to external sensors through a military-style circular connector. 使用可选的外部传感器时, 通过军用圆形的连接器将外部传感器连接到记录器上。

The inputs from the sensors are double stage transient protected and allow a maximum voltage of $\pm 14\text{V}$ on any input with respect to the recorder's PGP round, and a maximum differential voltage of $\pm 26\text{V}$ across signal pairs. 来自传感器的输入具有双级瞬间保护网络, 并且允许任一输入最大电压为 14V (相对于记录器的 PGP 接地而言), 双端信号相对最大电压为 26V 。

THE K2

The outputs from the board, $+12\text{V}$, -12V , the calibration coil and calibration enable lines are transient protected to prevent damage to the driving circuit in the recorder. 由电路板输入的 $+12\text{V}$, -12V , 标定线圈和标定线路, 均具有瞬态保护电路, 以防止损害记录仪中的驱动电路。

THE MAKALU

The outputs from the board, $+13.75\text{V}$, -13.75V , the calibration coil and calibration enable lines are transient protected to prevent damage to the driving circuit in the recorder.

Caution: The K2's $\pm 12\text{V}$ and the Makalu's $\pm 13.75\text{V}$ power is designed to power the EpiSensor. Other sensors and may require separate power supplies. See Chapter 6 for more information.

告诫: K2 的 $\pm 12\text{V}$ 和 Makalu 的 $\pm 13.75\text{V}$ 电源是为 Epi 传感器设计的。其它传感器需要独立的电源。为了获得更多的信息, 阅读第 6 章。

The mating connector is supplied with the board. It is an FCI 851-06EC14-19PN50 and can be ordered from Kinometrics as P/N 851119. Cables can also be ordered from Kinometrics and further details of cabling to common sensor types can be found in Chapter 6. 相匹配的连接器随同电路板提供, 它是 FCI 851-06EC14-19PN50, 并可以从 Kinometrics 订购 (P/N 851119)。电缆也可以从 Kinometrics 订购。普通传感器连接电缆的进一步详细说明在第 6 章中可查到。



To ensure that the recorder meets the conducted and radiated RF emissions requirements of the European Union, a FerriShield (KMI P/N 840734) should be attached to this cable. 为了确保记录器满足欧共体管理和辐射的射频发射需要，FerriShield(KMI P/N 840734)应连接到电缆上。

Table 13: External sensor input

Pin 针序	Name 名称	I/O 输入 /输出	Description 描述
L	Channel 1+第一道的+	Input 输入	Positive signal input to channel 1 differential input pre-amplifier. Input impedance 100k Ω min. Use for "high-side" of single-ended connection. 第一道差分输入前置放大器的正信号输入极。输入阻抗最小 100k Ω 。用作单端连接的高端。 Makalu only: +/- 10V levels with respect to common. Differential connection from + to - inputs. 40Vp-p full scale = 2 ²⁴ ADC counts.
M	Channel 1 -	Input 输入	Negative signal input to channel 1 differential input pre-amplifier. Input impedance 100k Ω min. Must be connected to common for single-ended connection. 第一道差分输入前置放大器的负信号输入极。输入阻抗最小 100k Ω 。对于单端连接必须连接到公共端。 Makalu only: +/- 10V levels with respect to common.
N	Channel 1 common	Ground 地	Signal common for channel 1 input amplifier. Use for internal shield. 第一道输入放大器的公共地线，用于内部屏蔽端。
A	Channel 2 +	Input 输入	See channel 1. 见第一道的说明。
B	Channel 2 -	Input 输入	See channel 1. 见第一道的说明。
P	Channel 2 common	Ground 地	See channel 1. 见第一道的说明。
C	Channel 3 +	Input 输入	See channel 1. 见第一道的说明。
D	Channel 3 -	Input 输入	See channel 1. 见第一道的说明。
R	Channel 3 common	Ground 地	See channel 1. 见第一道的说明。
E	Cal 标定 DAC	Output 输出	Calibration DAC signal to EpiSensor to provide "step" voltage. Normally set to 0 except during "FT" event. During the two "step" pulses, the signal swings to +2.5V then to -2.5V then back to 0. 为传感器提供数-模转换的阶跃电压信号；除了在“FT 功能测试”事件进程中，正常均设为 0。当功能测试时，先发正阶跃信号（+2.5V），再发负阶跃信号（-2.5V），然后归零。
F	Cal Coil Enable 标定线圈可用	Output 输出	Enables cal coil switch 设定开关，使标定线圈为可用。
K	EpiSensor common 传感器公共端	Ground 地	Main ground between external EpiSensor and recorder. 外接传感器与记录仪之间的地线。

J	+ 12 V	Output 输出	K2: +12V DC power for EpiSensor or other similar sensor. 为 Epi 或其它类似传感器提供+12V 电源。 Makalu: +13.75V DC for EpiSensor or other similar sensor.
H	- 12V	Output	K2: -12V DC power for EpiSensor or other similar sensor. 为 Epi 或其它类似传感器提供-12V 电源。 Makalu: -13.75V DC for EpiSensor or other similar sensor.
V	Cable drain 缆线	Ground 地	"Quiet" analog ground used internally to connect input board to ADC board. 连接记录仪内部的输入板与 ADC 板公共地。
U	PGP	Ground 地	Protective ground plane. Connects directly to recorder chassis. Transients are "shunted" directly to this ground plane. Use for non-signal external cable shields. 保护地。直接连接仪器外壳，用于无信号外部电缆屏蔽。
G	Digital and power ground 数字和电源地线	Ground 地	Not normally used. 正常不用。
S, T	N/C		No connection is made to these pins on the EpiSensor input board. 在 Epi 传感器输入板，不用此 2 线。

表 13 外接传感器输入

Firmware Overview 固件综述

The firmware in the recorder controls all aspects of system operation. This section discusses the three components of the firmware and provides a very general overview of the function of each. The following section discusses specific software features in more detail.记录器的固件控制着系统运行的全过程。这部分讨论了固件的组成，并提供了每种功能较全面的论述。对于特殊的软件功能进行了更详尽的讨论。

Boot Loader 引导装载器

The Boot Loader module is executed by the main system board's HC16 whenever the unit is powered up. It pauses to allow the user to load new firmware (if you tell it to) or, in normal operation, a time-out occurs and the Application Block is executed. The Boot Loader allows new firmware to be loaded into the unit through the RS-232 port or modem as described in Chapter 4. 当设备电源接通时，引导装载模数的过程是通过主系统板的 HC16 来执行的。当它暂停时，允许用户装配新的固件（如果你让它这样做）或者在正常运行中，超时信号产生时就执行应用程序块。引导装载允许通过 RS-232C 端口或者第四章所描述的 modem 进行。

Application Block 应用程序块

The Application Block runs when the Boot Loader exits after timing out. This is the MCU code that controls the operation of the HC16 main processor. Its first task is to configure FPGAs in the system and download the DSP code to the DSP in the system.

The Application Block then starts the DSP program, performs some additional hardware initialization and begins acquisition. The Application Block continues to run, controlling the system operation, user interface, data storage, communication with the user, and configuring and controlling the ADC/DSP subsystem.

The Application Block is written in C and uses a RTOS (real time operating system) to control operation of the various software tools in the system.

The DSP code is contained within the Application Block and controls the code to control the DSP on the main board. The code image is stored in the MCU's flash memory and the MCU loads the code into the DSP's SRAM memory as part of the Application Block's initialization.

The DSP code controls the ADC chip and acquires the input data stream at 2000 sps. The DSP program then filters this data to produce the data stream for the MCU at the final output rate. The code also provides the trigger filtering and trigger algorithm.

The DSP code is written in Assembler to maximize the speed and efficiency of the recorder's operation.

在引导装载完成，并等待超时条件满足后，装载程序退出，应用程序块启动。

这是 MCU 代码，它控制着 HC 16 主处理程序的运行。首要任务是在系统中配置 FPGA 以及下载 DSP(数字处理信号)代码到 DSP 系统中。

于是，应用程序块启动 DSP 程序，实施一些附加硬件的初始化并且开始检测。应用程序模块继续运行，它控制系统的运行、用户界面、数据存储、用户通信、配置，并监控 ADC/DSP 系统。

应用程序块写进 C 中，并且使用一个 RTOS（实时操作系统）来控制系统中不同工具软件的运行。

DSP 代码包括在应用程序块中，通过控制代码来控制主板上的 DSP。表征码存储在 MCU 闪烁存储器中。作为应用程序块初始化的一部分，MCU 将代码写入 DSP 的 SRAM 存储器上。

数字处理信号代码控制模/数转换（ADC）芯片，而且产生 2000 sps 速率的输入数据流。然后，DSP 程序将此数据滤出，以最后要求的输出速率产生 MCU 输出数据流，代码也确定了触发滤波和触发的规则。

为了最大限度地提高速度和记录仪运行的效率，DSP 代码用汇编程序中写成。

Firmware Features 固件特性

This section describes some additional details of the algorithms used in the recorder. These details may help users understand the operation of the system. 本节记述一些用在记录器里的额外的运算法则的详细资料，以帮助使用者理解系统的运行。

Filtering and Decimation 滤波和抽样筛选

The DSP filters and decimates the 2000 sps data from the ADCs using multi-rate FIR filters in the following way:

The first stage filter A is a non-causal FIR-type filter with 47 coefficients at a 250 Hz sampling rate, 57 coefficients at a 200 Hz sampling rate, and 113 coefficients at a 100 Hz sampling rate. The 2 kHz data stream from the A/D converter is decimated by a factor of 4 at 250 Hz final sampling rate, by a factor of 5 at 200 Hz sampling rate, and by a factor of 10 at 100 Hz sampling rate. All data from the A/D converter enters the filter input buffer. However, filter output is calculated only at the fourth, fifth, or tenth sample, depending on the final sampling rate. The data output rate from the first stage filter is twice the final output data rate: 500 sps for 250 sps output, 400 sps for 200 sps, and 200 sps for 100 sps output.

数字处理信号 (DSP) 使用复合速率 FIR 滤波器, 从 ADC 中抽取 2000sps 的数据。其处理过程如下:

第一阶滤波器 A 是一个无源 FIR 滤波器, 在 100Hz、200Hz 和 250Hz 的采样率上的滤波效率分别为 113, 57 和 47。

在末级采样率为 250Hz 时, 对来自 A/D 转换器的 2 kHz 数据流抽取率为 1/4, 在末级采样率为 200Hz 时, 对来自 A/D 转换器 2KHz 数据流的抽取率则为 1/5, 在末级采样率为 100Hz 时则为 1/10。来自 A/D 转换器的数据输入到滤波缓冲级, 和末级输出的采样速率相关, 而仅在第 4, 第 5, 第 10 个数据上采样作为滤波器的输出。即来自第一阶滤波器的数据输出是双倍的末级输出数据速率: 250sps 输出 500sps, 200sps 输出 400sps, 100sps 输出 200sps。

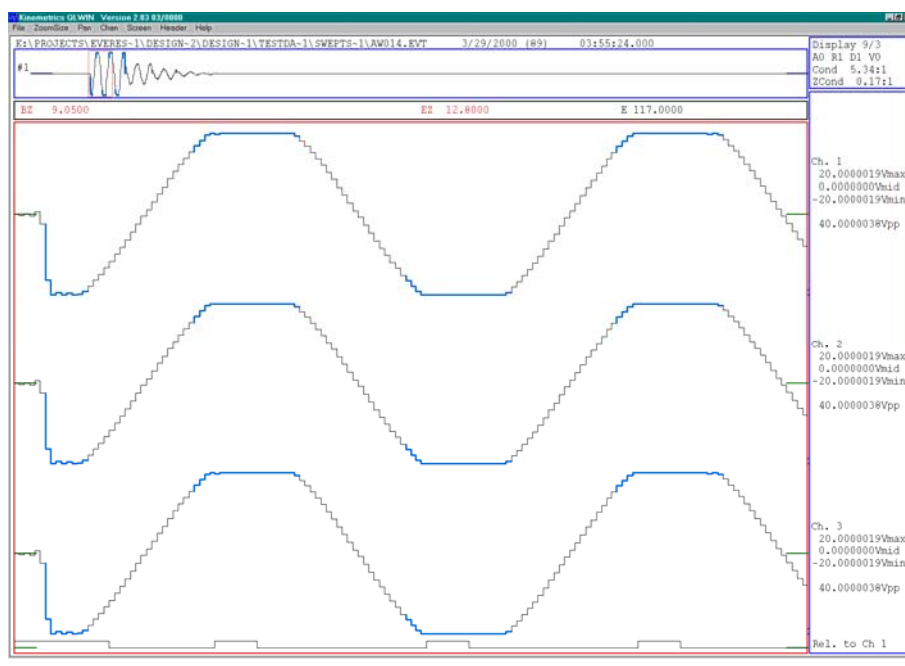
CAUSAL/ACAUSAL FILTERING 有源诱导/无源非诱导滤波

The final-stage filter B is either causal or acausal depending on your selection. It has 137 coefficients at all sampling rates in acausal form, and 111 in its causal form. The final output is derived by applying the filter to every second sample and outputting the result. 末级滤波器 B 是无源的。对所有的采样率它具有 137 个常数。其末级输出是经过采样滤波的。

K2 CLIP INDICATOR K2 限幅指示

The ADC indicates when it senses an overload condition at its input. This is represented as a full-scale positive or negative input for that sample in the DSP. As the DSP performs the FIR filtering this overload condition can be filtered down to an unsaturated value. Thus, there can be a situation when there is no indication of this overload condition in the final output. For this reason, the LSB of the K2's 24-bit data sample is set to 1 if a sample within the FIRs length is saturated. This "clip indicator" can be used to check for saturated

inputs. 当判断输入信号超载时，ADC 就显示。它是 DSP 采样的满屏正负输出的象征。当 DSP 进行 FIR 滤波时，能够将这种超载信号滤波到饱和值以下。这样，当超载指示无显示时，表明末级的输出正常。由于这一原因，如果 FIRs 长度内的采样是饱和的，Etna 24 位数据采样的最低有效数字 (LSB) 为 1。所以可以用这个“快速限幅指示器”检查饱和输入。



MAKALU CLIP INDICATOR MAKALU 限幅指示

Due to the higher resolution inherent in data recorded by the Makalu, the clip indicator has been moved from the LSB of the 24-bit data word sample to the 0.1 sec. frame headers, making the maximum dynamic range of the ADC and DSP filters available.

When QLWIN is used to view recorded data, frames with raw clipped 2000 sps data samples will be indicated by a wider trace.

Clipped input data to the FIR filters is not always recognizable because of the smoothing effects of these filters. Hard clipping will always be apparent. The figure below shows the QLWIN display of a 50Vp-p signal.

Figure 39: QLWIN display of 50Vp-p signal

图 39 50 Vp-p 信号的 QLWIN 显示

Be certain to take clipping effects into account when analyzing large signals.

K2 GROUP DELAY K2 群延迟

In older versions of the K2, the group delay of the ADC and digital filters were not compensated and group delay was shown in the file header. From

application code 2.20 onward, the group delay in the event file header is 0.0 and the time stamps are accurate for the first scan and the trigger scan. 在 K2 固件的旧版本中，ADC 的群延迟和数字滤波是没有补偿的，而且群延迟表示在文件头段信息中，从应用软件 2.20 版以后，事件文件的头段信息中，群延迟是 0.0，这个数据对首次扫描和触发扫描的时间标志是精确的。

Table 14: Corrections made by the MCU in the K2

表 14 用 K2 内的 MCU 做校准

SPS 采样率	Non-causal 诱导 empirical mSec	Causal 诱导 empirical mSec	Sample period 采样周期 mSec
20	1900	400	50
40	950	200	25
50	860	260	20
100	380	80	10
200	195	40	5
250	160	40	4
1000 (SRT)	44.0	14.0	1

MAKALU GROUP DELAY MAKALU 群延迟

The Makalu also compensates for the group delay of its digital filters; its net group delay is effectively zero.

Table 15: Corrections made by the MCU in the Makalu

SPS	Non-causal empirical mSec	Causal empirical mSec	Sample period mSec
20	2350	400	50
40	1200	225	25
50	1120	340	20
100	480	90	10
200	250	55	5
250	200	48	4
1000 (SRT)	58	20	1

表 15 用 Makalu 内的 MCU 做校准

The figure below shows the compensated group delay. IRIG-E time code from a source that is known to be accurate to GPS is recorded on the analog channels. The analog inputs are driven with an open-collector driver so slow fall time is due to the effects of the pull-up resistor and input capacitors. Rise time is short enough for the test.

The Makalu's generated IRIG-E time code is looped-back to its own IRIG input to show its internal time (which is also locked to GPS). Note that the positive edges of the two IRIG time codes are lined up.

Figure 40: Example of Makalu group delay test

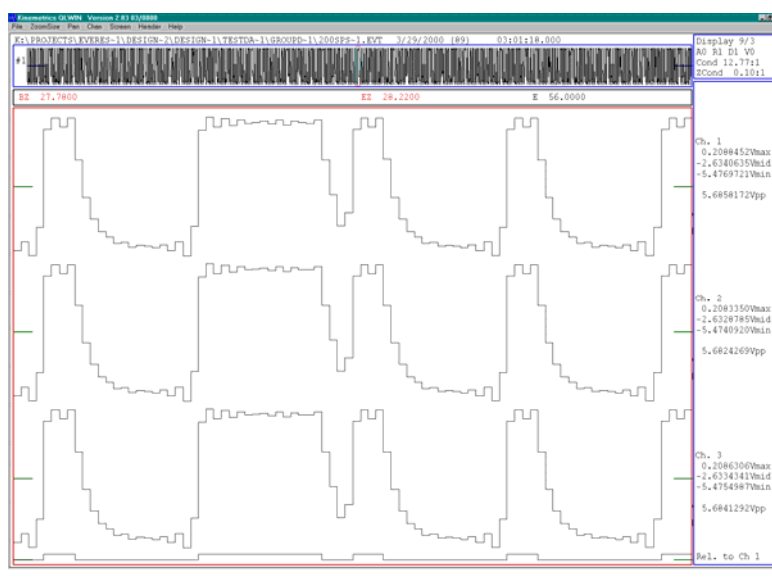


图 40 Makalu 群延迟试验实例

STA/LTA Triggering 长、短项平均触发

The STA/LTA trigger in the recorder has several novel features in the algorithm to improve performance. These algorithms are described below. 记录器中的 STA/LTA 触发器，其算法有几个新特性以提高性能。这些算法介绍于后。

For computational reasons, sliding window averages are not calculated, but exponentially weighted averages are used. Consequently, not only the samples during the STA or LTA windows determine their values, but also previous samples contribute to a small degree to the calculated values. This small difference has no significant practical consequences. 因为计算上的理由，滑动窗平均是不计算的，而是使用指数加权平均。因而，不仅样品由于 STA 或 LTA 窗决定它们的数值，而且先前的样品对于计算值在较小程度上也起一份作用。这些小的差异没有明显的结果。

Once an event is declared, its LTA value is essentially frozen. In the first approximation, it remains constant until the event is over and recording stops. This is a required condition to keep a realistic STA/LTA ratio value for de-triggering purposes. Note that the STA/LTA ratio should reflect the ratio of temporal earthquake signal to noise level prior to the event. 一旦，发现一个事件，它的 LTA 基本上被固结。在此开始的近似里，它保持常量直到事件过去和记录停止。这是一个要求的状态，以为去触发的目的维持实际的 STA/LTA 比值。请注意 STA/LTA 比应反映暂存的地震信号对于先于事件之前的噪声水平的比值

However, in the recorder's algorithm, a small-signal energy leakage of the signal into the LTA is still allowed for the following reason. In the rare case

where man-made seismic noise abruptly increases above the de-trigger threshold level during event recording (for example, by switching on machinery close to the site), a completely frozen LTA would not allow the STA/LTA ratio to fall below de-trigger threshold value at all. 可是，在记录器的算法中，该信号进入 LTA 的小信号能量泄漏依然是被允许的，其理由如下。在事件记录过程中人造地震噪声突然增加到去触发阈值水平之上的极端场合（譬如，在靠近该处有机器正在打开），一个完整地固结的 LTA 不总是容得 STA/LTA 比值根本下降到去触发阈值之下。

In effect, the "event" would last forever, eating up all available memory. Due to this small energy leakage, the LTA still increases slowly with time, thus decreasing the STA/LTA ratio. Eventually it becomes smaller than the de-trigger threshold level and recording terminates. 实际上，该“事件”将持续永久，占尽了所有可用的存储。由于小信号能量泄漏，LTA 依然随时间缓慢地增长，因而 STA/LTA 比值减小着。最终地使比值小于去触发阈值水平和记录终止。

An additional refinement is built into the STA/LTA trigger algorithm that improves the recording of some regional and many teleseismic events. In many such events, seismic energy arrives at seismic stations in several "packets" with little or no signal between them. With a standard STA/LTA trigger algorithm, such events are frequently dissected into several files or secondary packets and are not recorded at all. 一个外加的精心安排被构建进入 STA/LTA 触发器算法，它改善一些地方震和许多远震事件的记录。在许多此类事件里，地震能量在几个“数据包裹”里到达地震台站，这些“包裹”间带有微小或没有信号。用标准 STA/LTA 触发器算法，此类事件将被频繁地割裂成若干文件或第二类包裹而不能得到完整的记录。

In the recorder's algorithm, when a signal falls below the de-trigger threshold level for the first time, the recorder begins "watching" for consecutive exceedence of de-trigger threshold levels, rather than for exceedence of the much higher trigger threshold level. This feature makes the instrument more trigger-sensitive immediately after each de-triggering for a certain amount of post-event time and thus allows for secondary packets within the same event file. 在记录器的算法里，当一个信号初次跌落到去触发阈值水平之下，该记录器开始“守候”连续超越去触发阈值水平而不是超越要高许多的触发阈值水平。此特性使得仪器在每次去触发后对于确定的事件后时间内立即可能更灵敏再触发，因而在同一事件文件里容得第二类包裹。

Makalu Dynamic Range & Noise

Makalu 的动态范围和噪声

The Makalu noise floor yields a typical dynamic range of 129dB at 200 samples per second. This figure has a deviation of approximately ± 1 db over different instrument and channels within the instrument. This corresponds to a dynamic range in "bits" of 21.5. This is precisely what the ADC chipsets used typically provide. This dynamic range is computed in the most conservative

way. It is based on the ratio of the RMS level of a full-scale, peak-to-peak sine wave, that is, 40Vp-p, to the RMS value of the AC component of the noise. Spectral techniques and additional filtering can be used to obtain higher values.

Before "believing" the dB calculation (which is based on the ratio of the full-scale RMS value to the RMS value of the noise), a power spectral density (PSD) calculation is performed. It is examined for any excessive spectral peaks.

Current acceptance criteria allow peaks at a maximum of 1.5dB in the flat portion of the PSD at 200 sps. Typically, a 30-minute record of 200 sps data is recorded with the inputs terminated using 100Ω low-noise resistors.

The performance of the unit at 250 sps offers a typical dynamic range of 128dB. At lower sampling rates the dynamic range improves with typical values of 131dB at 100 sps, 133 dB at 50 sps, and 135 dB at 20 sps. To obtain the best performance at low frequencies it is important that the unit is mounted in a thermally stable environment away from air currents. A well-designed seismic vault with fiberglass or polystyrene insulation to stop convection currents is a good test site for low frequency performance.

Note: Allow the unit to thermally stabilize for several hours before running the tests.

NOISE TESTING FOR THE MAKALU MAKALUD 的噪声试验

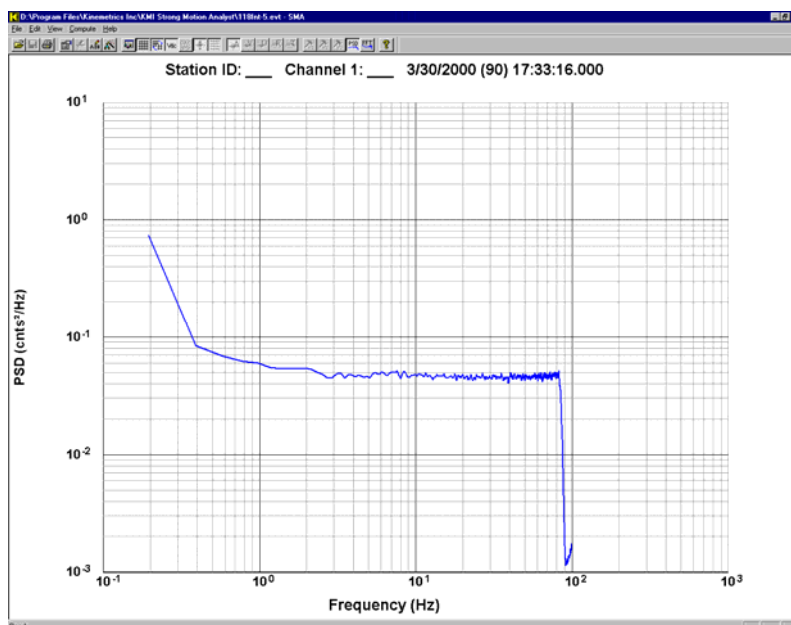
KWNTF is not recommended for use with the Makalu. Instead, use spectral processing to verify that the response is flat and use the ratio of RMS noise to RMS clip levels to compute dynamic range.

Kinematics' Strong Motion Analyst (SMA) can be used for this purpose. Alternately, the KW2ASC and KW2CNTS can be used to create an ASCII file that can be processed with commercially available signal processing software packages.

The following PSD plot from Kinematics' SMA software package shows the typical noise spectra as recorded on the Makalu. This record was obtained using 100 Ω low-noise resistors to terminate the inputs and shows the flat response in the "flat portion" of the passband.

Figure 41: PSD computation of noise test data

图 41 噪声实验数据的 PSD 计算



This uncorrected QLWIN time series shows the excellent DC drift characteristics. This is a 30-minute record – but remember that the internal temperature of the Makalu must be allowed to stabilize before achieving this level of performance.

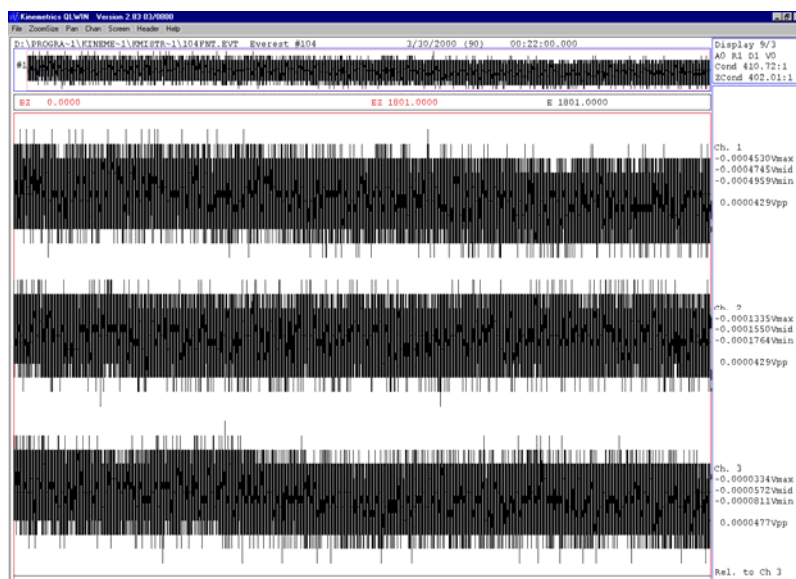
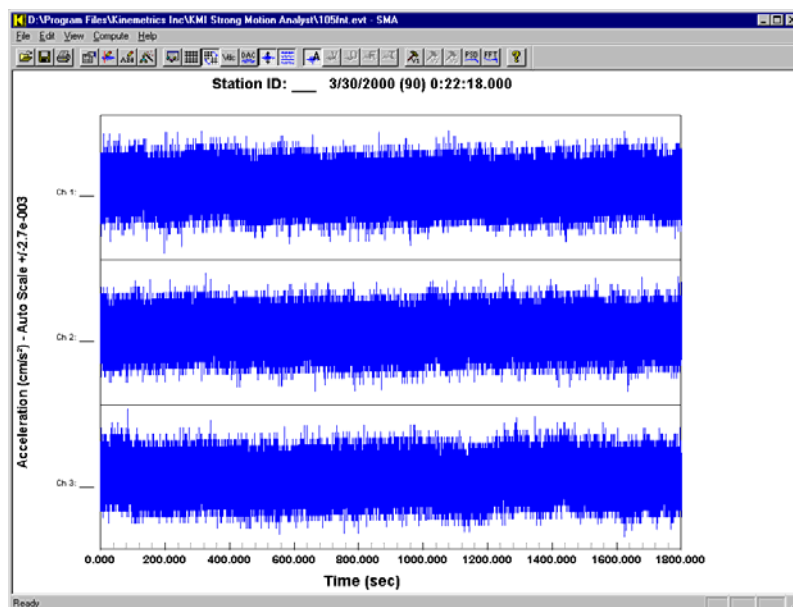
Figure 42: QLWIN display of noise test data

图 42 噪声试验数据的 QLWIN 显示

Though there is little drift in the record, a linear least squares fit applied to the time series by the SMA before computing does "improve" dynamic range. This is considered acceptable because there is a finite limit to the noise bandwidth. Non-linear drift is not removed by the baseline correction. Values considerably less than 129dB are obtained if there is excessive drift.

Figure 43: SMA display of baseline corrected noise test data

图 43 基线校准噪声试验数据的 SMA 显示



Upon command, SMA reports the dynamic range in a pop-up Notepad window. These are typical values for the Makalu.

Figure 44: Dynamic range calculation

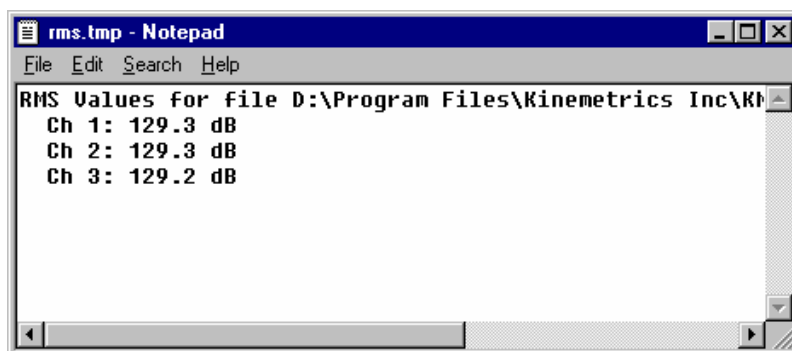


图 44 动态范围计算

The dynamic range is calculated by computing the standard deviation of the noise data and comparing it to the RMS level of a full-scale sine wave. The peak value of the sine wave at full scale is 2^{23} or 8,388,608 counts. Its RMS level is then 5,931,642 counts ($\text{peak}/\sqrt{2}$).

KWNTTP reports the standard deviation for channel 1 at 2.75 counts. This yields a dynamic range of 128.7dB. The dB level is computed as $20\log(\text{noise}_{\text{RMS}}/\text{FS}_{\text{RMS}})$. Correcting the baseline with the least squares fit improves the value to 129.3dB as reported by the SMA. This, and because the KWNTTP scales the data to K2 scale factors means that KWNTTP should not be used for Makalu noise testing.

For reference, K2 full-scale voltage is $5V_{\text{PP}}$ or $1.77V_{\text{RMS}}$. The Makalu is $40V_{\text{PP}}$ or $14.14V_{\text{RMS}}$ – 18dB higher. The noise for the two instruments is $3.5\mu V_{\text{RMS}}$ for the K2 and $5.0\mu V_{\text{RMS}}$ for the Makalu. The Makalu noise floor is about 3dB higher than the K2. The net increase in dynamic range is therefore about 15dB or 2.5 bits at 200 sps.

Figure 45: KWNTP histogram of Makalu noise

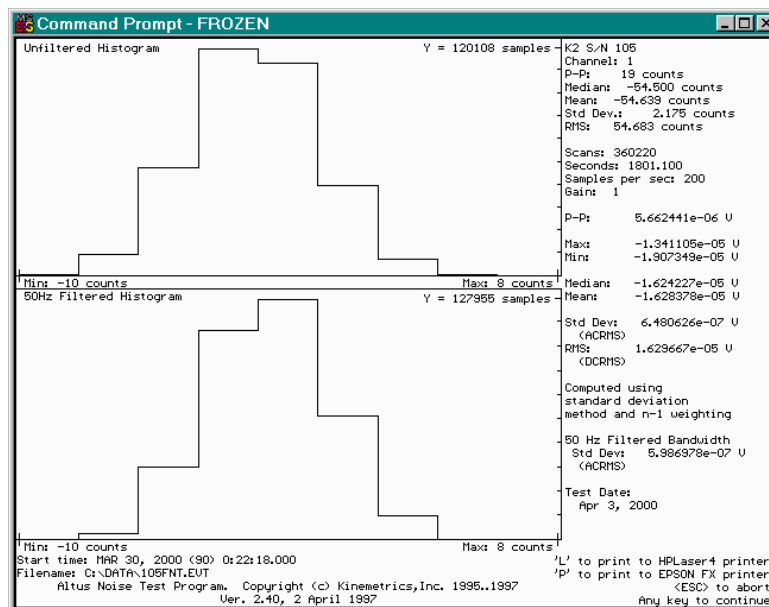


图 45 Makalu 噪声的 KWNTP 直方图

STEPPED SINE WAVE TEST 阶梯正弦波试验

Another test performed during production is a stepped sine wave. Using a programmable function generator, the test is started with a shorted input, then $50V_{pp}$ is applied.

The generator is then "stepped" in a 1, 2, 5 sequence down to $20\mu\text{V}_{\text{pp}}$. Then the QLWIN display is panned across to look for anomalies. The following figures show the entire test, a zoom of the 50V section and a zoomed view of the end of the test showing the $20\mu\text{V}$ section. Notice that the $20\mu\text{V}$ section is quite resolvable. This record was recorded at 20 sps.

图 46 阶梯正弦波—全部记录

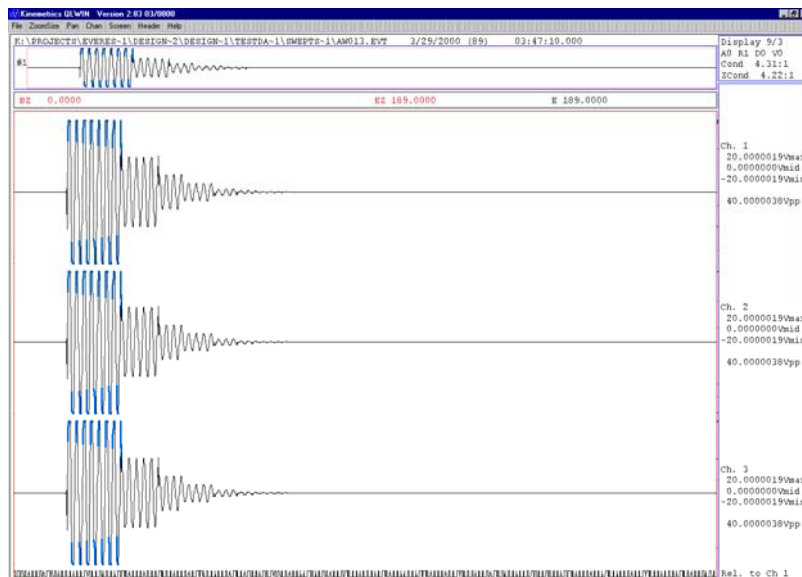


Figure 47: Stepped sine wave – 50v section

图 47 阶梯正弦波—50V 部分记录

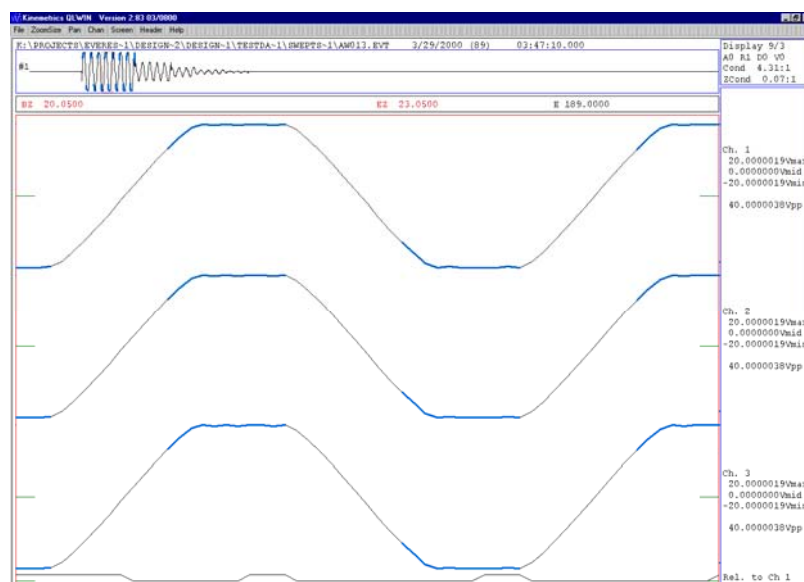
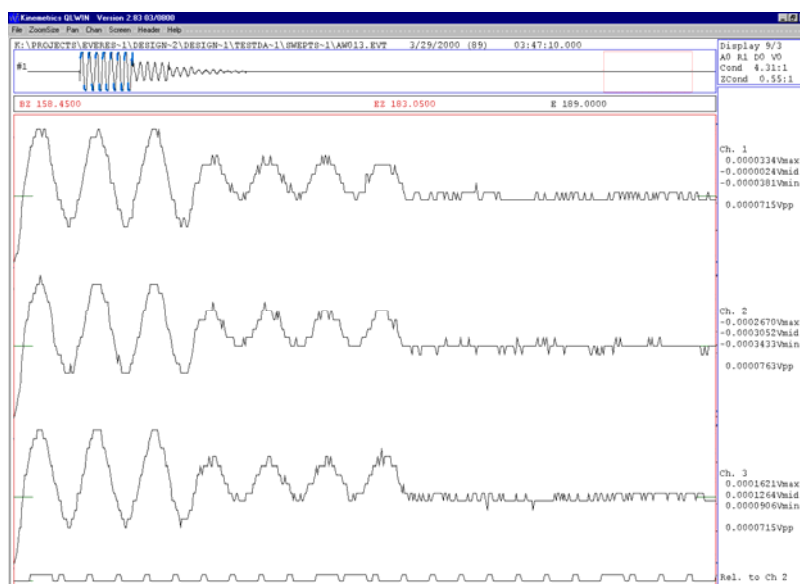


Figure 48: Stepped sine wave – 20 μ v section图 48 阶梯正弦波—20 μ v 部分记录

6. Advanced Installations 高级安装

Overview 总论

This chapter describes a number of advanced installations and features that may be used with the recorder. If you require further help with any of these advanced installations, contact Kinemetrics' services department. 这一章叙述了记录仪的高级安装和使用。如果你需要进一步了解高级安装，请接触 Kinemetrics 公司服务部。

External Sensors 外接传感器

The K2 can be used with up to 12 external uniaxial sensors and up to 4 triaxial sensors, depending on the number of recording channels in the instrument. The Makalu supports 1/2 this number. K2 可使用多到 12 个外部单轴传感器或 4 个三轴传感器，这取决于仪器内的记录通道数量。

Connections are provided through the optional external sensor I/O board. The sections below explain how to connect sensors to this interface. 通过外接传感器 I/O 板选件提供连接。本节下面介绍如何连接传感器到该接口。

EpiSensor ES-U

Consult the *EpiSensor ES-U User Guide* for further information regarding the connection of external EpiSensor ES-U's with Altus series recorders. 请参阅 *EpiSensor ES-U User Guide* 以更进一步地了解外接 EpiSensor ES-U 与 Altus 系列记录器的连接。

EpiSensor ES-T

Consult the *EpiSensor ES-T User Guide* for further information regarding the connection of external EpiSensor ES-Ts with Altus series recorders. 请参阅

EpiSensor ES-T User Guide 以更进一步地了解外接 EpiSensor ES-T 与 Altus 系列记录器的连接。

Changing Internal EpiSensor Range & Voltage Levels on the K2 改变 K2 中内置 EpiSensor 的量程和电压水平

We recommend leaving the configurations of the K2's internal EpiSensor unchanged. If there is a need to change them, use caution and verify any changes with a tilt test and/or calibration sequence. 我们要求 K2 的内部传感器设置保持不变。如果需要改变设置，使用跳线变换实现对加速度计测量范围和电压等级的改变。这个操作应该在实验室用转台试验和/或计算序列实现，而不是在野外进行。在进行这个操作之前，我们要求对人员先进行培训。

The full-scale range is configured by putting jumpers on headers X1 and X4 on the feedback board of individual EpiSensor modules. Both jumpers must be set correctly or the sensor will not function properly. The location of the headers is shown in figure 53. 把各 EpiSensor 传感器模块反馈板上的跳线器 X1 和 X4 设置在合适的档位就可以改变满刻度的量程范围。X1 和 X4 这两个跳线档位的设置都必须正确，否则，传感器将不能正常工作。跳线位置见图 49 所示。

The following table shows the sensitivities available for the jumper-selectable ranges on the K2. 下表 16 指出了关于 K2 的跳线-选择量程的有效灵敏度。

Table 16: Range/sensitivity calculations

表 16 量程/灵敏度计算

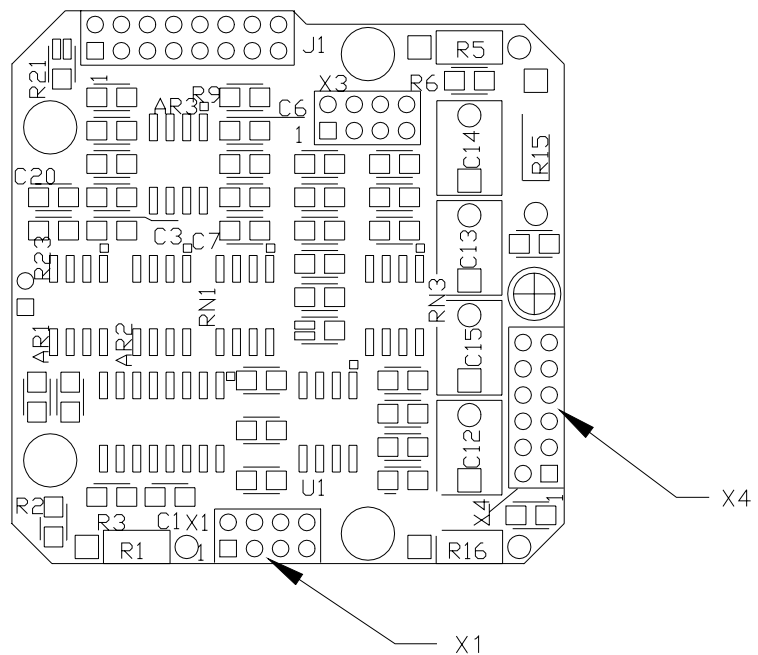
Full-scale range 满 刻度量程	Single-ended $\pm 2.5V$ output 单 端输出	Single-ended $\pm 10V$ output 单 端输出
1/4g	10 V/g	40 V/g
1/2g	5 V/g	20 V/g
1g	2.5 V/g	10 V/g
2g	1.25 V/g	5 V/g
4g	0.625 V/g	2.5 V/g

Figure 49: EpiSensor feedback board**图 49 EpiSensor 反馈板**

Configure each range by installing jumpers (indicated by the black rectangles) as shown in Figure 54. 通过跳线的正确组合可以设置每一个通道的量程范围，如图 50 所示（由黑色矩形所标注）。

Note: For clarity, we have numbered each connector pin in the figure, however; only #1 will appear on the actual feedback board.

注意：为了更加清楚，在图中我们对每个连接器的引线进行了编号，但是，在实际的反馈板上只能看见 1 号引线。

Figure 50: Full-scale range jumper settings**图 50 满量程跳线设置**

Output Voltage Level 输出电压水平

There are three, 3-pin jumper-headers that control the output voltage level. These headers reside on the top (oscillator) board of the deck. While referring to the table below, install one jumper at each connector location to select the voltage output level for that axis. For the 2.5V output, install the jumper between pins 1 and 2; for the 10V output, between pins 2 and 3. 标准输出电

	Header X1				Header X4					
	2	4	6	8	2	4	6	8	10	12
1/4g										
	1	3	5	7	1	3	5	7	9	11
1/2g										
	1	3	5	7	1	3	5	7	9	11
1g										
	1	3	5	7	1	3	5	7	9	11
2g										
	1	3	5	7	1	3	5	7	9	11
4g										
	1	3	5	7	1	3	5	7	9	11

压由 3 个分别由 3 根引线组成的跳线控制。这些按钮置于传感器（振荡器）层面板的顶部（见图 51）。在每个连接器上安装一个档位用于选择所对应的那个通道的标准输出电压（如表 17 所示）。在引线 1 和 2 之间对应一个档位，其输出电压为 2.5V，在引线 2 和 3 之间为另一个档位，输出电压为 10V。

In most applications with the internal deck, the 2.5 V output is appropriate. 在绝大多数的实际应用中，2.5V 输出是比较适宜的。

Figure 51: Internal EpiSensor oscillator board

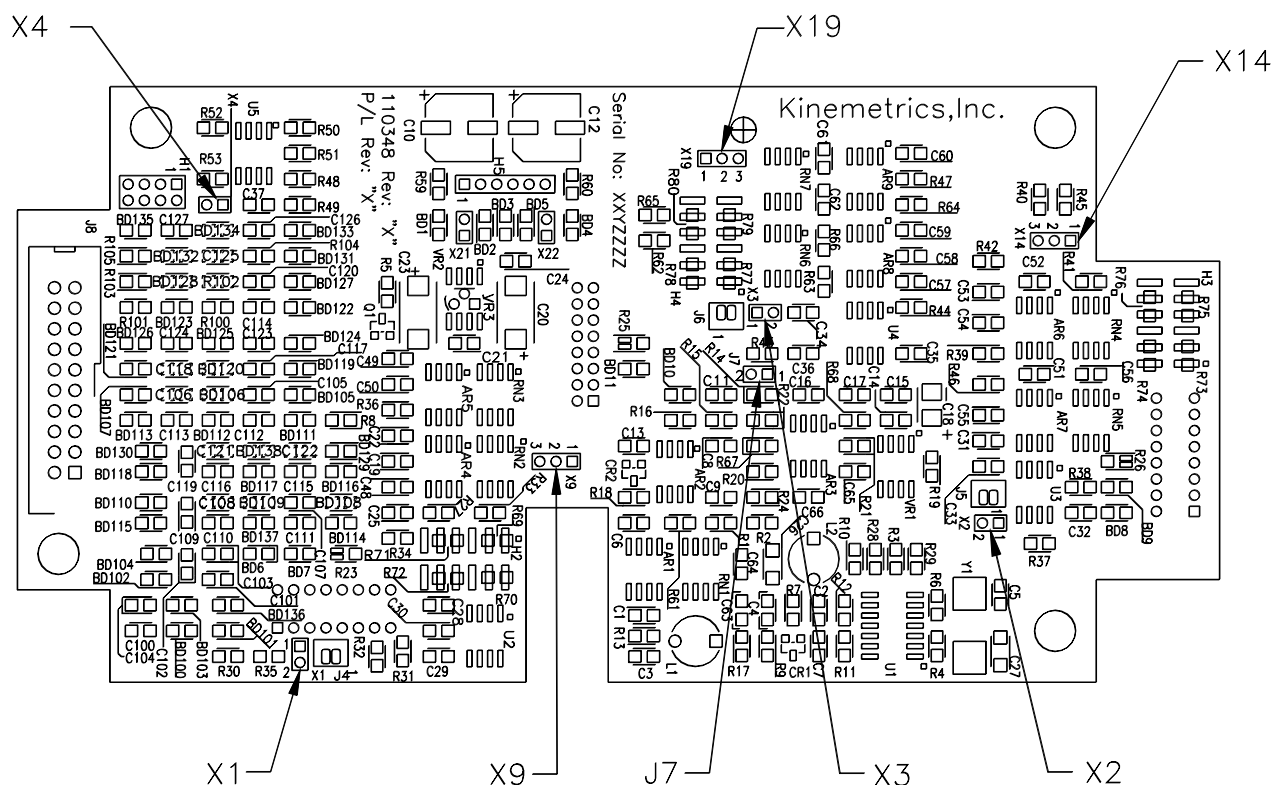


图 51 内置 EpiSensor 振荡器板

Table 17: Output voltage-level jumper settings

表 17 输出电压水准跳线设置

Axis 通道	Header 跳线	2.5V Output 输出	10V Output 输出
X	X9	1-2	2-3
Y	X14	1-2	2-3
Z	X19	1-2	2-3

Because the internal EpiSensor is more sensitive to noise, it is not offered with the low noise option available on EpiSensor ES-Ts. 在传感器 ES-T 上没有提供选择低噪声的档位，因为内置传感器对噪声灵敏度的要求比较高。

Additional Jumper Settings 附加跳线设置

There are several additional jumpers on the oscillator board. Jumpers X1, X2 and X3 are normally installed. If these are removed, the calibration coils for each axis can be accessed, generally for factory test procedures. 在振荡器线

路板上有几个附加档位。跳线器 X1、X2 和 X3 时正常地设置。如果改动这 3 个档位，就可以访问相应通道的标定线圈，它们通常用于工厂的测试程序中。

HypoSensor

The HypoSensor (downhole EpiSensor package) can be connected to a recorder using the transient protection box (P/N 108390-03-PL for a HypoSensor without a compass or P/N 108390-04-PL for a HypoSensor with a compass) and two cables. One cable runs from the recorder to the transient protection box and one from the transient protection box to the HypoSensor. The transient protection box is strongly recommended because the HypoSensor has limited lightning protection circuitry. The connection between the transient protection box and the HypoSensor should be made by matching the designators as shown on both the protected side of the transient protection box and Table 17. HypoSensor 传感器(井下 EpiSensor 成套件)可用瞬变保护盒 (P/N 108390-03-PL 用于传感器没有罗盘定位装置的，P/N 108390-04-PL 用于传感器有罗盘定位装置的)和 2 根电缆将其与记录器相连；一根电缆连接瞬变保护盒和记录器，另一根电缆连接瞬变保护盒和传感器。因为传感器只有有限度的避雷保护电路，所以我们强烈建议使用瞬变保护盒。该瞬变保护盒与 HypoSensor 之间联结时应注意符合瞬变保护盒上的指示标识和表 18 规定。

WARNING! Potential lethal voltages. Potentially lethal voltages can exist between the conductors on the cable or the exposed metal parts of the HypoSensor in these configurations. These occur due to differences in ground potential between the location of the recorder and the location of the HypoSensor. Faulty electrical wiring returning large currents to ground normally causes these differences. It is the user's responsibility to ensure that hazardous conditions are not created and that all local electrical safety regulations are observed.

警告！潜在危险电压。潜在的危险电压可能存在于电缆的电线之间，或者是传感器裸露的金属部分，发生这种情况是由于在记录仪的位置和传感器的位置之间存在着不同的接地条件。疏忽了电线对大地之间可能存在的电位差，就会引起较大的电流。用户的职责就是确保不能产生这种危险。必须遵守当地所有关于用电的安全规则。

Table 18: HypoSensor Connection

表 18 HypoSensor 连接

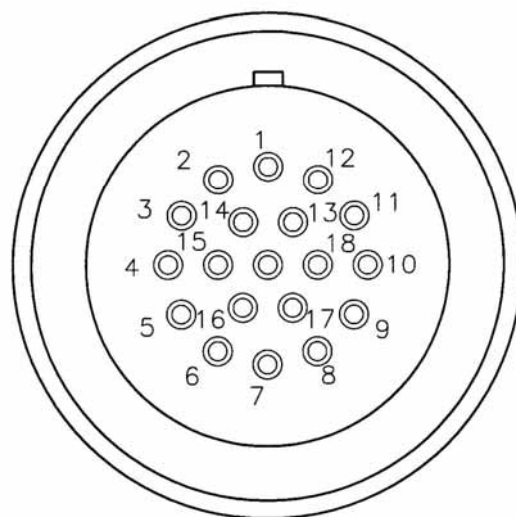
External Connector 外部连接器	Transient Protection Box 瞬变保护盒	Downhole Cable 井下电缆 700306
--------------------------	--------------------------------	----------------------------

J1	J1, J3	J4	Cable Assembly Wiring Chart 电缆组件布线图表		
			Cable wire colors 电缆线颜色 on 700306	Function 功能用 途	Connection pin number on HypoSensor 传感器 连接针脚数字
L	1		TP1 red 红色	L signal 信道	1
M	2		TP1 white 白色	L return 反馈	2
N	3		TP1 shield 屏蔽	L shield 屏蔽	
A	4		TP2 green 绿色	V signal 信道	3
B	5		TP2 white 白色	V return 反馈	4
P	6		TP2 shield 屏蔽	V shield 屏蔽	
C	7		TP3 yellow 黄色	T signal 信道	5
D	8		TP3 white 白色	T return 反馈	6
R	9		TP3 shield 屏蔽	T shield 屏蔽	
K	13		Black 黑色	Common 公共地	7
U	15		Cable shield 屏蔽	Shield 屏蔽	8
		5	Blue 蓝色	RS-232 gnd	9
		4	TP4 black 黑色	RS-232 txd	10
		6	TP4 white 白色	RS-232 rxd	11
		7	TP4 shield 屏蔽	RS-232 shield 屏蔽	
		3	Orange 橙色	Compass signal 罗 盘信号	12
		2	White 白色	Compass 罗盘 +12V	13
			Not connected	未连接	14
E	10		Green 绿色	标定 CCE	15
F	11		Yellow 黄色	标定 Cal DAC	16
J	12		Red 红色	+ 12V	17
H	14		Brown 棕色	- 12V	18
			Not connected	未连接	19

Figure 52: Mating connector on downhole cable 700306

图 52 匹配井孔电缆 700306 的连接器

CONNECTOR DETAIL (FACE VIEW SHOWN)



Legacy FBA Instruments 传统的 FBA 仪器

Certain Kinemetrics legacy FBA instruments continue to be supported by the K2, however we do not recommend using these instruments with an Makalu. (Their output voltage is too low and their noise is too high to allow full realization of the dynamic range of the Makalu.) Please see the sections below for information on connecting to a K2. K2 对某些 Kinemetrics 老式传统 FBA 仪器继续保持兼容，然而我们不建议将这些仪器与 Makalu 连用。（由于这些仪器输出电压太低和仪器噪声太高，不能使 Makalu 的大动态范围性能得到充分利用。）请看本节下面关于连接到 K2 的信息。

FBA-23s

The FBA-23 is an external triaxial force balance accelerometer. Refer to *The FBA-23 Force Balance Accelerometer User's Guide* (P/N 302350) for specific instructions regarding the installation or fabrication of cables and operation of the FBA-23. **FBA-23s** 是一个外部的三轴力平衡加速度计。关于安装、电缆装配以及 FBA-23 操作的具体指令可以查阅 *FBA-23 力平衡加速度计 (P/N 302350) 用户手册*。

FBA-11s

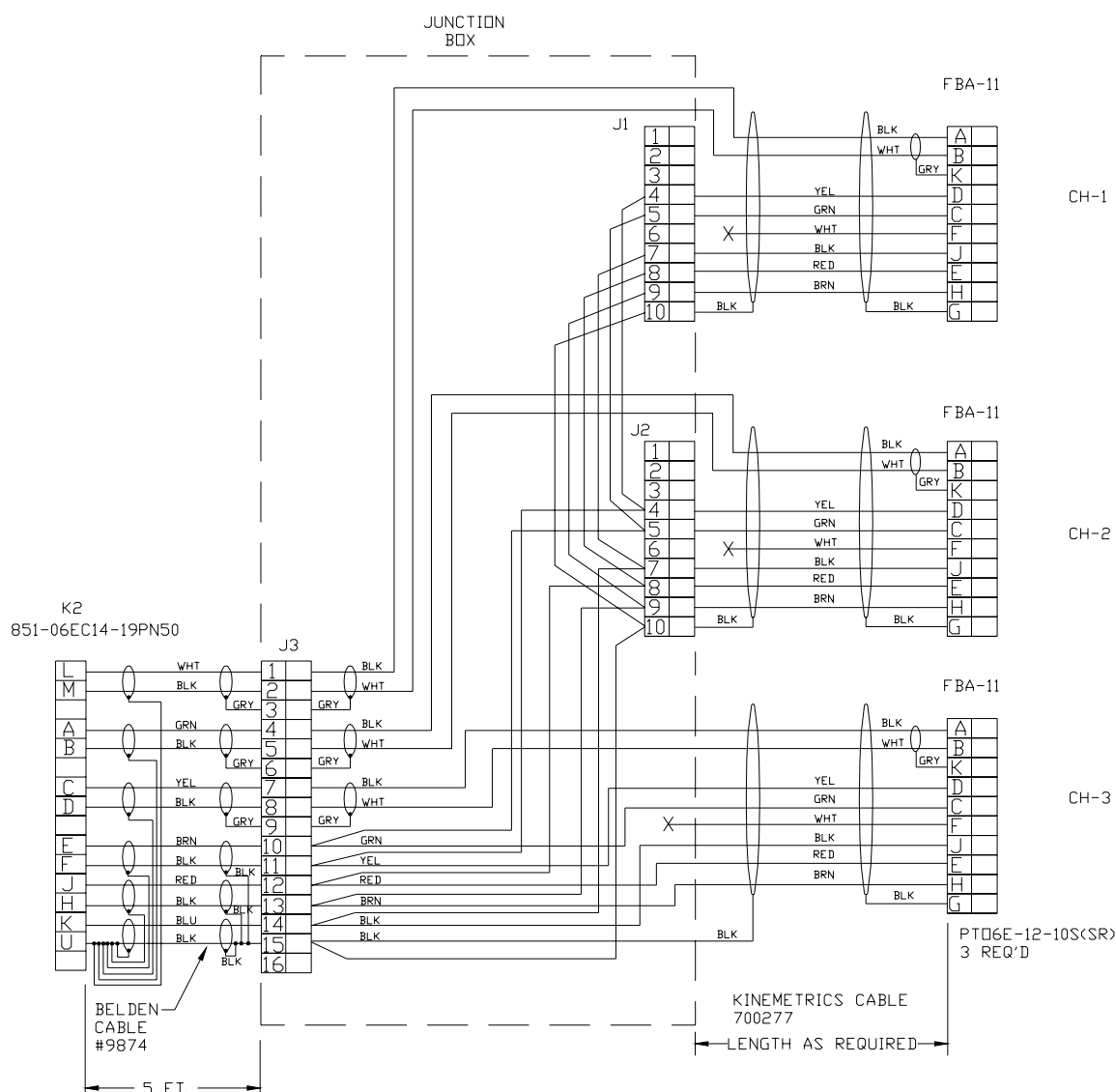
The FBA-11 is a single axis force balance accelerometer used for monitoring structural vibration in one direction.

Three FBA-11s can be connected to each external connector on the K2. Refer to Figure 53 to produce the cable and junction box required to connect FBA-11s to the K2.

Refer to *Operating Instructions for FBA-11 Force Balance Accelerometer* (P/N 105000) for specific instructions regarding the installation and operation of the FBA-11.

FBA-11s 是一个单轴力平衡加速度计 (P/N 105000)，用于监测在一个方向上的结构震动。

K2 上的外部连接器可以连接 3 个 FBA-11s，从图 53 可以看出，需要用电线和连接盒把 FBA-11s 和 K2 连接起来。



关于安装和 FBA-11 操作的具体指令可以查阅 *FBA-11 力平衡加速度计操作手册*。

Figure 53: Connecting an FBA-11 to the K2

图 53 FBA-11 与 K2 的连接

Passive Seismometers 无源地震计

This section describes the use of the recorder with a passive seismometer. Specific details of connecting a Kinemetrics SS-1 are given. The information can be used to connect and configure passive seismometer or geophones from other manufacturers.

Connecting an SS-1 连接 SS-1

The SS-1 Ranger seismometer is a passive electromagnetic sensor with a constant generator of 340V/m/s in open circuit. The SS-1 can be connected to a K2 with or without a gain board.

The SS-1 can be connected to an Makalu with or without a gain board. A gain board is recommended for optimum system performance.

SS-1 CONNECTED TO A RECORDER WITHOUT A GAIN BOARD 将 SS-1 连接到未配置增益板的记录器

When the SS-1 is connected to an Makalu or a K2 without a gain board, the damping resistor can be mounted in the connector that is attached to SS-1. This resistor has a typical value of 4.75 Kohms. The exact value of the resistor can be taken from the SS-1 data calibration card. Considering the input impedance of the K2, the damping resistor should be computed as follows:

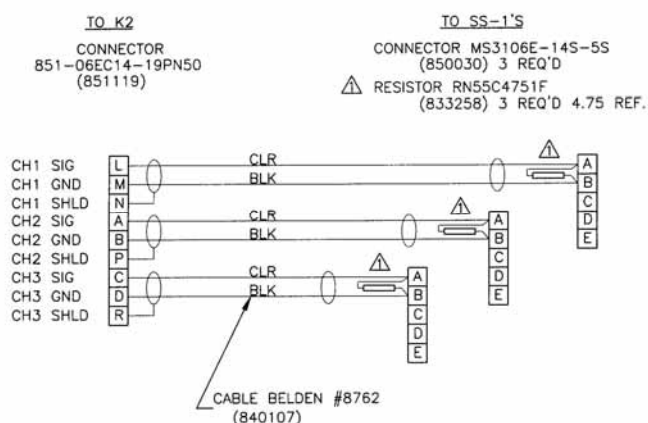
$$R_{df} = (R_d \times 200) / (200 - R_d)$$

where:

R_{df}	Final damping resistor value (Kohms)
R_{act}	SS-1 damping resistor for 0.7 critical damping from data calibration card (value in Kohms)
200	Combination of the two (200 kΩ) bias return resistors already present in the circuit

Figure 54: To connect an SS-1 to the K2

图 54 SS-1 与 K2 的连接



SS-1 CONNECTED TO A K2 OR MAKALU WITH GAIN BOARD 将 SS-1 连接到配置有增益板的 K2 或 MAKALU 记录器

When the SS-1 is connected to a K2 with a gain board, the damping resistor must be installed on the gain board. The value of the damping resistor should be computed as indicated in the gain board operating instructions. The connection can be made using the same cable drawing (501755) without installing the damping resistor on the SS-1 connector side because it is already installed on the gain board. Refer to the gain board operating manual (KMI Document 302206) for more details on these topics.

In this case the value of the damping resistor can be computed using the following formula:

$$R_{\text{act}} = (200 \times R_d) / (200 - R_d)$$

where:

- R_{act} Required damping resistor in Kohms
- R_d SS-1 damping resistor for 0.7 critical damping from data calibration card (value in Kohms)
- 200 Combination of the 200 k Ω bias return resistors already present in the circuit of the gain boards.

Caution: It is important that the passive attenuator is not used with a "passive" sensor. It is designed to scale the output of active sensors to the K2's input range. It should also not be used with a Makalu.

Active and Broad Band Seismometer

有源宽带地震计

Broadband active seismometer can be connected to either a K2 or Makalu. For a K2 the output of some broadband seismometers may need to be attenuated using the gain board option. The Makalu is designed to directly interface with broadband seismometers, such as; the STS-2, with 20V differential (40Vpp) output. Refer to the seismometer manufacturer's manual for installation details. Care needs to be taken to ensure the seismometer is correctly powered. The Altus recorder may not be able to supply sufficient power.

Instructions below are specific for Kinometrics WR-1 instrument connected to a K2.

Connecting a WR-1 to a K2 连接 WR-1 到 K2

The WR-1 Ranger seismometer is an active, single-component sensor that can output DC-coupled acceleration and AC-coupled acceleration and velocity. The sensor requires +/-12Vdc power of 20mA.

Due to this current requirement, a K2 with three channels can support one WR-1. If the sensor is connected to a K2 with 6 channels, then a maximum of two sensors can be connected. If the sensor is connected to a K2 with 12 channels, then each set of six channels (1-6 and 6-12) can support a maximum of two WR-1s directly connected. In all cases, EpiSensor-type accelerometers can be used with the remaining channels.

If the total number of WR-1s connected to one K2 exceeds the above numbers, then either a junction box or an external battery box must be used to provide power for the WR-1. The junction box is P/N 501720-25-PL and the battery box is P/N 106835-03-PL for DC and P/N 106835-04-PL for AC.

Options on the Auxiliary Connector

关于辅助连接器的选项

This section describes how to use some of the hardware features available on the auxiliary I/O connector. 本节阐述如何使用关于辅助 I/O 连接器的一些硬件特性。

Interconnected Units and Common Triggering

互连单元和公共触发

LOCAL INTERCONNECT METHOD 局域互连方法

Prepare an interconnect cable that includes the signals as shown in the wiring diagram included as Figure 55. One unit should be designated as a master unit. It will supply an IRIG time code signal to the entire group or array of

interconnected recorders in the rare event that the GPS does not provide common timing. 请按图 55 所示线路图准备一根信号互联电缆。用一台仪器作为主单元。在 GPS 不能提供公共时间服务的罕见事件里，它将提供一个 IRIG 时间代码到整个互联的记录器组或台阵。

Additional information on the electrical characteristics of the interconnect signals can be found in Table 13, auxiliary pin descriptions.关于互连心耗电特性的附加信息可在表 13，辅助接脚描述栏里查找。

PARAMETER SETTINGS FOR INTERCONNECTED UNITS

互连单元的参数设置

A few parameters must be set properly to ensure that the interconnected groups of recorders operate correctly. They are: 为使互联记录器组正确运行必须恰当地设置几个参数。它们是：

- Pre-Event Time 事件前预存时间
- Post Event Time 事件后时间
- Stream SPS 数据流采样率
- Minimum Run Time 最小运行时间

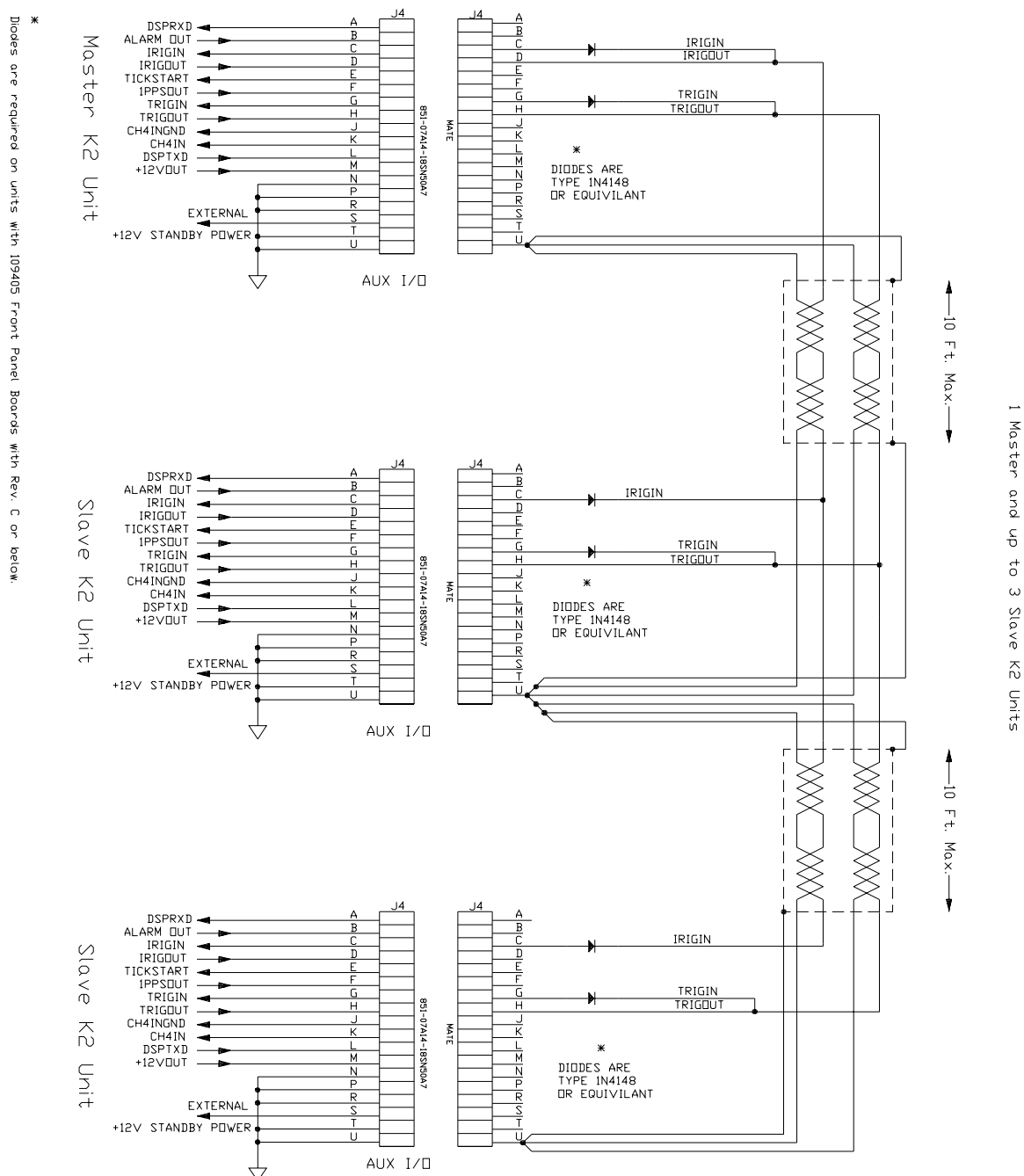
These should be set to "legal" values and should be the same for all recorders. Otherwise, the files will not be time-aligned. 这些应置为“法定”值，且对于所有记录器应相同。否则，该等文件的时间将不匹配。

- External Trigger Votes 外部触发器票决

The external trigger should have enough votes to trigger the unit assigned to it. Normally, the number of votes should be equal to the weight. If the weight is one, one vote is sufficient. 外部触发器应有为触发该单元所分配给它的足够的票数。常规地，此票数应等于权重。

Figure 55: Interconnecting with the local interconnect method

图 55 用局部互连方法进行互相连接



TIMING CONSIDERATIONS FOR INTERCONNECTED UNITS

互连单元的时间考虑

It is preferable if at least the master unit has a GPS timing option. This is essential if the data recorded by the group of interconnected recorders will ever need to be correlated with data recorded by another recorder or group of recorders. 如果在主单元至少有一台 GPS 时间选件，那是最好的。如果由互联记录器组记录数据甚至将需要与用另外的记录器或记录器组记录的数据相关联，这是根本的。

- If no GPS is available and an IRIG time code must be used for common timing, it will be necessary to process the files and align their starting and ending points to the points in time. 如果不可能用 GPS，而只能用 IRIG 时间代码作为公共时间，则将必须处理这些文件，将它们的起始和末端点与时间点匹配。

MASTER/SLAVE OR SHARED GPS OPERATION 主/从模式或分享 GPS 运行模式

Altus recorders can operate with GPS in one of two modes: Altus 记录器能够用两种 GPS 方法之一去运行。

Free field mode is the traditional Altus GPS usage. In free field mode, each recorder is equipped with an individual GPS receiver, and obtains independent timing and positional information. In this mode, recorders can have individual antennae or can share a common antenna. 自由场方式是 Altus GPS 的传统用法。在自由场方式里，每个记录器需要带一个 GPS 接收器，并且获取其单独的事件和位置信息。在此方式里，记录器能够有单独的天线或能分享一个公共天线。

In master/slave mode, also called shared GPS, a group of Altus recorders may share GPS information from a single GPS receiver and antenna. In this mode, one recorder designated as the master is equipped with a GPS antenna and receiver. The master is responsible for obtaining GPS information and then broadcasting time and positional information to the slaves over a dedicated serial interconnect link. The slaves take information received from the master and process it in a manner very similar to how they would process data from a private GPS receiver. 在主/从方式（也称分享 GPS 方式）里，一组 Altus 记录器可以从一台单个 GPS 接收器分享 GPS 信息和天线。在此方式里，以一台记录器作为主单元配备一套 GPS 天线和接收器。该主机负责获取 GPS 信息并接着通过专用串行互联链路发播时间和位置信息到各从机。从机取得来自主机所接收的信息并用非常类似于处理单个 GPS 接收器数据的办法处理它。

Free field and all Altus recorders, including the Mt. Whitney, Makalu, K2, and Etna support shared GPS modes. Both modes provide accurate timing for common sampling and triggering. 自由场和所有 Altus 系列记录器，包括 Mt. Whitney, Makalu, K2, 及 Etna 都支持分享 GPS 方式。两种方式都为公共采样和触发提供精确时间。

Pros and Cons: 专业要点

- Free field mode is simpler to set up in many cases 在许多场合自由场方式设置简单。
- Free field mode with a shared GPS antenna may make sense in some cases where a single antenna is required, the extra antenna cable is not a problem, and common triggering is unnecessary 带有分享 GPS 天线的自由场方式在某些场合可感知何处合适安装单个天线，无需额外的天线电缆，并且无需公共触发。
- Shared GPS interconnect hardware can be expensive for some configurations 对于某些配置，分享 GPS 互联硬件可能是昂贵的。
- Shared GPS mode requires only one antenna for a group of recorders 用分享 GPS 方式对一组记录器仅需要一个天线。
- If using interconnects for common triggering, shared GPS requires no additional cabling 如果使用互联公共触发，则分享 GPS 无需附加额外电缆连线。

EXTENDED INTERCONNECT OPTION 扩展互连选项

Recorders can be interconnected using the local interconnect signals furnished on their auxiliary I/O connector (labeled AUX I/O). The signals are *TRIGIN*, *TRIGOUT*, *IRIGIN*, and *IRIGOUT*. This interface is designed to operate across approximately 10 ft. or 3m. 记录器可用在其辅助 I/O 连接器(标记为 AUX I/O)上提供的局部互联信号进行互联。该等信号是 *TRIGIN*, *TRIGOUT*, *IRIGIN*,及 *IRIGOUT*。此接口被设计用来为仪器间距约 10 英尺或 3 米内运行的。

The Extended Interconnect Option (P/N 109450) allows this distance to increase to 4000 ft. or more. It also converts local interconnect-level signals to RS-485-level signals, provides optical isolation, and can be used as a "repeater" to extend the total end-to-end distance of the network well beyond 4000 ft. 扩展互连选项(P/N 109450)允许此距离增加到 4000 英尺或更多。它也转变局部互联级信号到 RS-485 级信号，提供光学隔离，以及能作为一个“中继器”以扩展台网端到端总距离可大大超越 4000 英尺。

COMMON TRIGGERING 公共触发

The trigger interface consists of a simple wired- or open-collector bus where any unit in the array can assert the trigger signal when its trigger criteria are satisfied. When the unit senses an external trigger input, it will trigger (providing the trigger votes and weight are set correctly). The MCU software senses the trigger inputs and asserts the trigger output at precise times in the ADC scan interrupt handler. 触发器接口构成一个简单的有线-或开放-集电器总线，在台阵里的任何单元当满足其触发限值时都能保持触发信号在该处。当该单元感知一个外部触发器输入时，它将触发（所提供的触发票数 and 权重都设置正确）。MCU 软件感知触发输入和保持在精确的时间触发输出到 ADC 扫描中断处理器中。

The trigger input is sensed early in the interrupt handler and the trigger output is asserted late in the handler. This "timing window" prevents ambiguous triggers that could allow the events to lose their time alignment. It is also important to note that the unit only asserts its trigger output when its trigger criteria are exceeded, based on its own sensor channels. 触发输入在中断处理器里是较早地被感知，而触发输出则是较迟地被保持在中断处理器里。

“ 时间窗 ” 防止那种会使事件失去时间匹配的模棱两可的触发。关注该单元当基于它本身传感器通道的触发限值被超出时仅仅保持它的触发输出，这点也是重要的。

The external trigger input, while participating in the decision to trigger (and open a file in a particular unit), is *not* included in the decision to assert the external trigger output. If it were, the entire group of recorders would "latch up" and continue to record until their storage devices filled up! 在多方参预决定触发（ 和在一个特定单元里打开一个文件 ）的同时， 外部触发输入是不被包含在决定保持外部触发中的。如果它是，则整个记录器组总会“ 锁住 ” 并连续地记录直到它们的存储装置被装满为止！

The parameter considerations for common triggering are the same for both local and extended interconnect methods. When master/slave or shared GPS operation is available, the appropriate parameter settings will be described in the supplementary operating instructions. 公共触发的参数考虑对于局部和扩展互联方法两者都是相同的。当主/从机或分享 GPS 运行是可能的，恰当的参数设置将在补充操作指示中介绍。

Hardware Timing Options 硬件时间选项

IRIG Connections IRIG (串行时间编码) 连接

IRIG connections are made on the J4 AUX/IO connector on the front panel. Pin C is IRIGIN and pin D is IRIGOUT. When using a single instrument or configuring a master unit in an interconnected array, the IRIGOUT must be connected to IRIGIN in order to have IRIG code recorded. There are two types of IRIG code available, IRIG E and IRIG H. IRIG E consists of 10-second time frames and IRIG H consists of 60-second time frames. The type of IRIGOUT can be selected in the Terminal window at the *Edit* prompt. To select IRIG E enter **IRIG 1**. To select IRIG H, enter **IRIG 2**. 在前面板上的 J4 AUX/IO 连接器用作 IRIG 联接。接脚 C 是 IRIGIN 和接脚 D 是 IRIGOUT。当使用单个仪器或在一个互连台阵配置主单元时，IRIGOUT 必须是被连接到 IRIGIN 为了有 IRIG 代码被记录。可能有两种类型的 IRIG 代码：IRIG E 和 IRIG H。IRIG E 构成 10-秒 时间帧 和 IRIG H 构成 60-秒 时间帧。IRIGOUT 的类型可以在 *Edit* 编辑提示符下的终端窗里被选择。为选择 IRIG E 输入 **IRIG 1**。为选择 IRIG H 输入 **IRIG 2**。

IRIGIN IRIG 输入

Available on AUX/IO connector pin C, IRIGIN is the time code input for recording purposes. This input is compatible with IRIG E and H formats (sampled at K2 sample rate) and is normally used for time correlation with instruments other than K2s. If positive-logic standard IRIG code is connected to this input, the recorded code will be inverted due to the active-low nature of the recorder inputs. This input is meant to be driven by a K2, Makalu, SSA or similar open-collector outputs (or devices with similar drive characteristics). The input threshold is set at 2.5V and the signal input is pulled up to + 5V with 4.7 k resistors. The input is considered "true" when it is pulled below 2.5 V. Input hysteresis is approximately 60 mV and the maximum voltage input must be limited to $\pm 14V$. The input is transient protected.

IRIGOUT IRIG 输出

Available on the AUX/IO connector pin D, IRIGOUT is inverted IRIG E (10-second frame) or IRIG H (60-second frame) time code generated by the recorder. It is used for time correlation with instruments other than recorders. When connected to inputs, recorded code will be positive logic. This output is active-low, open-collector transistor. It is intended to be connected to recorder signal inputs, SSA inputs, or similar devices.

There is no pull-up resistor on this line and it must be pulled up by the input to which it is connected. The maximum pull-up voltage is $\pm 20V$. This output can "sink" 100 mA at 70° C with a saturation voltage of approximately 170 mV. If this output is connected to inductive loads such as relays, appropriate spike-suppression diodes must be used. This output is transient protected at $\pm 14V$.

K2 Fourth Channel Input K2 的第四通道输入

The input for channel four on a four-channel K2 is on AUX/IO connector pins J and K. (A fourth channel is not available on the Makalu.) This connection is not available on six- or twelve-channel units. Pin K is the positive analog input and pin J is the negative analog input. The input resistance to these pins is 100K Ω with a full-scale voltage of $\pm 2.5V$. 在 4-通道 K2 上的通道-4 的输入是在 AUX/IO 连接器接脚 J 和 K。(在 Makalu 上没有第 4 通道。)在 6-或 12-通道单元上也不会有此种联接。接脚 K 是 + 模拟输入, 接脚 J 是 - 模拟输入。在这些接脚上带有满刻度电压为 $\pm 2.5V$ 时的输入电阻是 100K Ω 。

These inputs are dual stage transient protected at $\pm 5.5V$. The input is protected with respect to the ground return and the chassis ground. This input is not as "clean" as the input of an external input board because the ground return to the ADC/DSP board is less effective. Common mode noise rejection is nominally 60dB. 这些输入是受 $\pm 5.5V$ 的两级瞬变保护的。输入关于接地回路和机架接地是被保护的。普通方式噪声抑制通常是 60dB。

If pins J and K are left open and channel four is recorded, "spikes" may be observed because of high input impedance from the IRIG code on the back plane of the instrument. Spikes can be avoided by not recording on channel four, connecting a sensor to it or shorting the inputs to ground. 如果接脚 J 和

K 被打开且通道-4 被记录，由于来自仪器背板上 IRIG 代码的高输入阻抗，“尖脉冲”可以被观察到。用在通道-4 上不做记录，连接传感器或短接输入到地可避免尖脉冲。

Hardware Alarms 硬件警报器

An alarm output is available on the AUX/IO connector pin on pin B. This line goes low when recorder alarm criteria are exceeded. It is latched until reset with the *CLEAR ALARM* command, *ALARM DURATION* = 0 or after the alarm duration is exceeded. The alarm duration is set at the * prompt by entering **Alarm Duration nn** where nn is the duration in seconds. 在 AUX/IO 连接器的接脚 B 上可提供警报输出。当记录器警报限值被超出时，该线走低。它被锁住直到该单元用 *CLEAR ALARM* 命令重置，*ALARM DURATION* = 0 或警报持时被超出。该警报持时在 * 号提示符下用输入 **Alarm Duration nn** 命令设置，此处 nn 是持时以秒 s 计。

If set to zero, the alarm is latched until the *CLEAR ALARM* command is issued. This output is an active-low, open collector transistor. It is intended to be connected to recorder signal inputs, SSA inputs or similar devices. There is no pull-up resistor on this line. It must be pulled up by the input to which it is connected. 如果置为 0，警报器被锁住直到发出 *CLEAR ALARM* 清警报命令。这输出是低电平有效，打开集电极晶体管。打算连接它到记录器信号输入，SSA 输入及类似的装置。在此线上没有阻止电阻器。必须用被连接的输入阻止它。

The maximum pull-up voltage is + 20V. This output can "sink" 100 mA at 70°C with a saturation voltage of approximately 170 mV. If this output is connected to inductive loads such as relays, appropriate spike-suppression diodes must be used. Output is transient protected at ± 14 V. 最大的阻止电压是+ 20V。此输出在 70°C 下带有饱和电压约为 170 mV 时，能“吸收”100 mA。如果此输出被接到电感应负载诸如继电器，必须用适当的尖脉冲抑制二极管。在 ± 14 V 下输出受瞬变保护。

Powering External Equipment 外接设备供电

A + 12V DC output is available on AUX/IO connector pin M for powering external equipment. The OPERATE/STANDBY switch controls this output. Current drawn should be less than 100 mA. The ground return can be pin N, P, R, T or U. 为了外接设备供电，在 AUX/IO 连接器的接脚 M 上给一个+ 12V DC 输出。OPERATE/STANDBY 开关控制该输出。电流应低于 100 mA。接地回路为接脚 N, P, R, T 或 U。

Controlling Power to External Telecomm Equipment 控制外接电话设备的电源

Recorder application code controls the cellular phone power control (CPPC) signal. The user can supply interface hardware to use this logic level signal to control power to cellular phones, external modems or other devices. 记录器运用代码控制蜂窝电话 (CPPC) 信号。用户可以通过硬件接口，应用标准逻辑信号控制蜂窝电话、外置 Modem 或其它设备的电源。

CONNECTION 连接

The signal is available on the Auxiliary I/O connector, Pin F, but you must set the *EDIT* mode command *CELLULAR POWER_CONTROL* because the line is shared with the 1 PPS out signal. 这个信号可通过辅助 I/O 连接器上的引线针脚 F 接入，但你必须设置 *EDIT* 模式 *CELLULAR POWER_CONTROL* 命令，因为该线与 1 PPS 输出信号分享。

CALL-IN/CALL-OUT WINDOWS 呼进/呼出窗口

The user can enable the CPPC line by setting start times and duration for five call-in windows. The warm-up time, which is the time from when the CPPC line is enabled until the call is actually started (modem goes off hook) can also be set.

The CPPC line is enabled for *WARMUP* time in seconds before an outgoing call and held on for two seconds after the call. However, the CPPC line will remain enabled after the end of the window if a user is still connected. If a user disconnects outside of an on-window, the system will wait five minutes before timing out and turning the CPPC off.

If a user loses a connection there is a five-minute window to reconnect. If the user terminates the call using the *ANSWERMODE* or *CALLMODE* command the CPPC bit is disabled shortly after entering *ANSWER/CALL* mode.

USING CALL-IN/CALL-OUT WINDOWS FOR TIMED RECORDING 用呼进/呼出窗口功能适时记录

The recorder can be made to record at specific times during the day by using the Call-In/Call-Out times. This can be useful for diagnostic testing. To use this technique, set up the Call-In/Call-Out window times for when you want the K2 or Makalu to record, as discussed in Chapter 3.

Set the minimum run time for the length of time you want the to record and use a short duration for the call-out. Give the External Trigger sufficient votes to trigger the system. Solder the CPPC pin (Pin F) to the External Trigger (Pin G) on an auxiliary I/O mating connector. Now every time the CPPC line is enabled the unit will trigger.

Connecting An External Battery 连接 外电池

The recorder can also be powered from an external battery at the *EXT POWER* connector:

Connect the battery as follows:

- Battery ground to pin F
- Battery +12V to pin E

To solder the external battery leads to the connector, you must temporarily remove the back shell from the charger's connector. The external battery input is reverse-voltage-protected and diode-isolated. You may use an external battery to replace or supplement the internal battery.

记录仪也能在外部电源接口上连接外部电池。电池连接方式如下：

- 电池地线接入引线 G
- +12V 电池接入引线 C

为了把外部电池连接至接口，必须暂时从充电器接口处打开后盖。外部电池输入时，通过由二极管组成的反向电压保护器。可以用外部电池替代或补充内部电池。



WARNING! Burn or fire hazard. Do not short the battery terminals with metallic conductors, such as a screwdriver or pliers. The battery can provide up to 80 amps of current. This amperage, when flowing through a non-isolated conductor, can result in very high temperatures and even fire.

Do not replace the supplied battery with a non-rechargeable battery or a battery that does not meet the requirements given in Chapter 4 in the *Replacing Batteries* section.

警告！燃烧或火灾危险。 不要用金属物体（例如螺丝刀或钳子）短接电池接线端子，因为电池能提供 80 安培的电流。80 安培的电流流经一个非绝缘体时，能产生很高的温度甚至导致火灾。不要用一个不能充电的电池或不符合要求的电池替换随设备提供的电池。在第 4 章有关“电池替换”的部分中给出了替换电池的规定。

User-Supplied Charging Systems 用户提供的充电系统

Recorder Input: *EXT POWER* connector pins E (+12V) and F (ground).

- Always consider the load current required by the equipment.
- Disconnect the internal battery when using high amperage external batteries.

For remote locations, a solar panel of approximately 75 watts can be used in conjunction with a charge controller and a car-type battery. Fuses and blocking diodes are recommended. Refer to Chapter 5 to calculate your recorder's specific current requirement to correctly "size" your solar charging system.

In locations where AC power is available, an AC/DC-type power supply with an output voltage of 13.5-14.2 VDC and a current output of 1-3 amps can be used to charge a car-type battery. Fuses and blocking diodes are recommended.

Please read the Safety section before working with the recorder batteries or power supplies.

记录器的外接电源插口：E 引线接+12V 电源，F 引线接地。

经常考虑仪器的电流负荷；

当使用高电流的外部电池时，不要连接内部电池。

对于偏远的地区，可以使用一个大约 75W 的太阳能电池，通过充电控制器和记录仪连接，建议使用保险丝和稳压二极管保护，参照第 5 章选择合适的太阳能充电系统。

在有交流电的地区，可使用输出电压 13.5-14.2V、输出电流为 1-3 安培的交直流转换器，该转换器也可给汽车电瓶充电，仍建议使用保险丝和稳压二极管保护。

使用记录仪和充电器时，请阅读安全部分内容。

Advanced Telecommunications Options 高级无线通讯选项

The manual has described using your recorder with direct RS232 connection and modem connections using POTs (plain old telephone) type connections. Depending on your needs and location, several other remote connection options are available.

Cellular and digital cellular phones are discussed below, but first, a bit of cautionary advice. While it is tempting to use one of the many low-cost telephones available, the issue of power must be considered. These telephones

are normally connected to a charger, which is connected to a power source, but if power is ever lost, most consumer-use phones have an on/off button that must be pushed in order to re-set or re-charge the phone. This is not a problem in the average household, but it is for remote sensor-sites. Kinometrics recommends that you research phone options and power considerations well before deciding on a unit.

除了本手册已经介绍的通过仪器的 RS-232 口，使用 MODEM 连接 Pots(老式明码电话)的通讯方法，还有一些远程连接选件，用户可以根据需要和当地的通讯条件选配。

下面介绍蜂巢电话和数字蜂巢电话。当准备使用各种低成本的电话时，必须首先考虑电源。这些电话一般都需要交直流变换器，一旦停电，多数电话会重新启动或给电话充电。偏远地区可能没有交流电，Kinometrics 公司建议用户在购买仪器前，先调研电源并以此设计远程通讯方式。

Cellular Phone Connections 便携蜂窝式电话连接

The cellular interface provides telephone communication wherever landlines are unavailable, impractical or too expensive. Single line telephone communication with the recorder is possible anywhere cellular service is available. This is particularly useful in remote sites that require data downloads.

All that is required for communication is a modem, a RJ-11 jack and a cellular phone. Not all phones are suitable, however. Select those that are DC-powered and have a dial tone available; we also recommend a transceiver with a 3-watt unit which will allow you to communicate even in fringe areas of cellular coverage. We have tested the Teluar Canada PhoneCell SX system and found it to work reliably and successfully with the recorder.

The modem speed should be kept between 2400-4800 baud. Our testing indicates that the PhoneCell can effectively transfer data at 4800 baud, but we recommend that you experiment in the field to see which rate works best.

蜂巢电话属于无线通讯方式，可为无电话线的地区或电话线建设成本太高的任何地方提供单向电话通讯服务（蜂巢电话覆盖区为前提）。尤其能为记录仪的远程遥控下载数据提供方便。

通讯所需设备有：一个 MODEM、一个 RJ-11（电话插头）、一个蜂巢电话。但不是所有的电话都合适，我们建议选择有直流电源、有拨号音的 3 瓦特的系统（transceiver with 3-watt），它可以保证在蜂巢电话覆盖区的边缘地带也能通讯。我们测试了加拿大的 Teluar Phone Cell SX 系统，发现该系统与记录仪的连接非常成功而且通讯可靠。

MODEM 的速率应在 2400-4800 波特之间，上述加拿大的电话能以 4800 的速率有效传输数据。我们也推荐使用经过野外实验工作证明良好的其它蜂巢电话网。

Digital Cellular Phones 数字蜂窝式电话

It is also possible to communicate with the recorder via a digital cell phone as provided in the U.S. by PacBell or Sprint's PCS service. This technology is referred to outside of the U.S. as "GSM." To use GSM or PCS to transmit data requires:

- A modem that supports GSM/PCS phones and the necessary cable (Kinometrics has used Siemen's GSM Modem M1)
- Data connection service (normal digital phone accounts support only voice communication; data transmission generally requires the purchase of additional service packages)

该记录仪可以通过数字蜂巢电话网通讯。例如美国 PacBell 公司和 Sprint's PCS 公司提供的服务。这项称为 "GMS" 的技术在全世界已经推广。用 GMS 或 PCS 传输资料要求：

- 支持 GMS/PCS 电话和匹配电缆的 MODEM (Kinometrics 公司已经使用了西门子公司公司的 M1 型 MODEM) ；
- 资料连接服务。一般的数字电话仅支持声音通讯，传输数据通常需要购买额外的服务包。

ISDN Access ISDN 通道 (综合业务服务网，即一线通)

ISDN connections can offer higher speed connections than POTs modem connections. A single-bearer channel can allow the recorder to operate at its highest RS232 baud rate of 57.6 Kbaud. External ISDN modems can be connected directly to the recorder's RS232 port. ISDN 系统能提供比 POTs MODEM 更高的通讯速率。ISDN 单通道可以使记录仪工作在 57.6kbps 的速度 (RS-232 口的最高速度)。外接的 ISDN MODEM 可以直接连接到记录仪的 RS-232 口。

Frame Relay Access 帧中继传播通道

Recorders can be connected to frame relay "clouds" using a FRAD (frame relay access device) and have been successfully connected at a baud rate of 57.6 k to continuously transmit digital data using the serial data stream. 使用一个 FRAME RELAY 接入器 (FRAD)，可以把记录仪接入 FRAME RELAY 通讯系统。该系统可以以 57.6kbps 的速度连续地传输数字资料。

Spread Spectrum Radios 展布频谱传输无线电

If your site is some distance from a phone system or the central recording station, but a line of sight exists, spread spectrum transmission can be used to establish a full duplex connection. Spread spectrum devices generally do not require a license and can easily operate over distances of 20 miles (links of >80 miles have worked in ideal conditions). 如果你所在地区距离电话系统或中心记录站较远，但又在视距之内，则可以考虑使用无线电通讯来建立

双向连接。通常无线电设备不需要许可证，在 20 余英里范围内容易实现通讯。（在理想的情况下，通讯距离可以达到>80 英里）。

Satellite Connections 人造卫星连接

Recorders can be accessed using satellite links. This field is advancing rapidly, so please contact Kinemetrix for the most current information on available satellite links. 记录仪还可以进入卫星网，该通讯领域发展很快。可与 Kinemetrix 公司联系，了解可以使用的最流行的卫星链接。

Paging 传呼（呼名页面调度）

The recorder can use its modem to call a paging service and send a simple text message. Contact Kinemetrix for more information on this topic or refer to the *Monitor Mode Communications User Guide* (302219) for more information. 记录仪也能利用其 MODEM,在预定情况发生时，进行呼叫服务和发送简单的信息。可与 Kinemetrix 公司联系，或参考 *Altus 监控模式通讯方法*（文件 302219），可以了解进一步的信息。

Makalu & K2 Specifications Makalu 和 K2 的特性

Input Channels 输入通道	
Sensor channels:传感器通道	K2: 3 standard 标准 (+1); 6 and 12 optional 选件 Makalu: 3 standard; 6 optional
Input level:输入电平	K2: Standard 标准 $\pm 2.5V$, optional 选件 40 Vpp ($\pm 10V$ differential 差分) Makalu: Standard 40 Vpp ($\pm 10V$ differential)
Gain:增益	K2: User selectable of x1, x3, x10, x30, x100 (opt)用户可选 Makalu: User selectable of x2, x6, x20, x60, x200
Damping:阻尼	K2: Provisions for internal resistor (optional) Makalu: Provisions for internal resistor (optional)
Data Acquisition 数据获取	
Type:类型	Over-sampled delta sigma system with 24-bit DSP 过采样 Δ - 系统
Anti-alias filter: 高频混淆	K2: Brickwall FIR filter. Cut-off at 80 % of output Nyquist; 120 dB down at output Nyquist Brickwall FIR 滤波, 在奈奎斯特频率以上的衰减为 80% (120db) Makalu: Brickwall FIR filter. Cut-off at 80 % of output Nyquist; -160 dB down at output Nyquist
Dynamic range system: 动态范围	K2: >114dB at 200 sps Makalu: >130dB at 200sps ~131dB Typical at 100 sps
Frequency response: 频响	DC to 80 Hz at 200 sps
Sampling rates:采样率	20, 40, 50, 100, 200, 250 sps
Chan.-chan. skew: 道间串扰	None – simultaneous sampling of all channels 无——所有通道同步采样
Acquisition modes: 获取方式	Continuous, trigger 连续, 触发
Output data format: 输出数据格式	24 bit signed (3 bytes)
Parameter calculations 参量计算	Calculations of key parameters in real-time 关键参量的实时计算
Real-time digital output 实时数字输出	RS-232 output of digital stream (contact factory for available formats) RS-232 数据流输出
Trigger 触发	
Type:类型	IIR bandpass filter (three types available) IIR 带通滤波器
Trigger selection: 触发选择	Independently selected for each channel 各通道独立选择
Threshold trigger: 阈值触发	Selectable from 0.01% to 100% of full scale 可从满刻度的 0.01%到 100%选择

Trigger voting: 触发表决	Internal, external and network trigger votes with arithmetic combination 内部、外部及网络触发；带有算术组合计算
Additional trigger: 附加触发	STA/LTA 短项平均/长项平均
Storage 存储	
Type: 类型	Fully compliant PCMCIA storage system (two slots) 全依从 PCMCIA 存储系统(2 槽)
Compatibility: 兼容性	PCMCIA standard 2.1; sockets accept type I, II, III card formats, type I or II modem 标准 PCMCIA 2.1 卡，允许 ， ， 格式的卡，也允许 和 型 modem 的接口。
Primary slot: 主插口	SanDisk; optional hard drive available for K2 with external sensors SanDisk; 对随带外接传感器的 K2 可选硬驱动
Secondary slot: 副插口	Same as primary slot 同主槽
Parallel slot: 并行插口	Accepts Type I or II modem with connectors 可与 和 型 modem 的接口连接。
Recording capacity: 记录容量	Depends on storage size 取决于存储容量
Recording format: 记录格式	Data is stored in DOS file system allowing cards to be read directly by PC. 资料存储在 DOS 文件系统，允许用 PC 直接读卡。
Firmware 固件	
Type: 类型	Multi-tasking operating system supports simultaneous acquisition and interrogation; boot loader allows remote firmware upgrades 允许多个操作系统；读取数据和讯问可以同时进行。装载引导器允许远程固件升级。
System control: 系统控制	Configure sample rate, filter type, trigger type and voting, maintains communications and event storage 采样率设置，滤波类型、触发类型和投票、维持通讯和事件存储
User interface: 用户界面	Packetized protocol, simple terminal loop control and data retrieval via RS-232 interface 打包协议、终端模式控制和数据回收经由 RS-232 通讯接口
Intelligent alerting: 智能警报	System can be configured to initiate communications when an event is detected or if an auto-diagnostic failure occurs 当发现事件或自动诊断失效时，系统可设置为主动启动通讯
Auto-diagnostics: 自动诊断	System can be configured to continuously check system voltages, temperature, RAM and code integrity, timing system integrity 系统可设置为连续检查系统电压、温度、RAM 及代码完整性、时间系统完整性
Rapid setup: 快速设置	Unit can be configured from parameter file stored in PCMCIA memory card 仪器能设置为将参数文件存储到 PCMCIA 记忆卡上
Timing 时间	
Type: 类型	Free running disciplined oscillator (standard); GPS (opt) 内设时钟振荡器或 GPS (选项)
GPS option: GPS 选项	Integrates completely with system, providing timing, internal oscillator correction and position information 具有振荡频率校正和定位功能
Timing accuracy: 计时精度	5 microseconds of UTC 绝对时间精度 5 微秒
Power cycling: 供电周期	Software controlled; consumption: 系统供电周期可用软件控制
Power consumption: 功耗	110 mA at 12V (active 动作时)
I/O and Display 输入/输出和显示	
Display: 显示	Matrix of 8 LEDs. Display indicates acquisition mode, event, recording,

	battery voltage, memory capacity used ; 8 LED 矩阵显示获取方式、事件、记录、电池电压、已用的存储卡容量。
Power input:电源输入	Mil-style connector for 24 Vdc charge input, external battery, standby power 为 24 Vdc 充电输入的军用型连接器 , 外部电池 , 备用电源
RS-232 input:RS-232 输入	Full RS-232C interface with modem control 具有 modem 控制的全 RS-232C 接口
Auxiliary input: 辅助输入	Mil-style connector for 4th channel input, IRIG out, IRIG in, clock sync., 1 pps out, trigger in, trigger out, alarm out, real time digital output (tx & rx), ext 12V out. Interface for interconnection of multiple units 军用型连接器 , 用于通道-4 输入、IRIG 出/入、同步钟、1 pps 时标信号、触发输入/输出、报警输出、实时数字输出 (收和发) , 外接 12V 电池输出 , 多单元互连接口
EMI/RFI protection: EMI/RFI 保护	All I/O lines are protected from both EMI/RFI emission and susceptibility problems by ferrite filters and transient suppressors 所有输入/输出线均符合 EMI/RMI 泄漏和用铁淦氧体滤波器及瞬变抑制器所引起的敏感性问题的保护。
Power Supply 供电电源	
Type:类型	High efficiency switched power supply and charger system 高效开关型供电及充电系统
Input:输入	Nominal 24 Vdc from charger 常规从充电器输入 24 Vdc
Operating range: 运行范围	10.5V to 15V
Ext. charger voltage: 外接充电器电压	100-260 Vac 50/60 Hz
Charging voltages: 充电电压	Temperature compensated for lead acid gel cell, 2; outputs with separate protection circuitry allows unit to recharge flat battery and work with reversed or damaged battery in multi battery system 电池系温度补偿的铅酸塑胶合 , 2 个 ; 个数出具有独立的保护电路 , 允许仪器对电池进行浮充电 , 并可在多电池系统里带有反极或损坏的电池时工作。
Fuses:熔断丝	Four 2 amp fuses for charger and batteries 对充电器和电池用四个 2 安培熔断丝。
Batteries:电池	Internal battery 内置电池 12V 12 Ah (standard 标准); external battery 外部电池 (opt 选项)
Current drain:电流量	K2: 380 mA @ 12V (depending on configuration; see Table 7 取决于设置 , 见表 7) Makalu: 365 mA @ 12V (depending on configuration; see Table 8)
Power autonomy:供电能力	>36 hours with internal battery 内置电池可供 36 小时(dependent on configuration 取决于设置)
Housing 防护外壳	
Type:类型	Lexan structural foam housing internally coated with EMI/RFI shielding material, 5/16" aluminum base support for mounting 带有电磁、射频防护 , 铝基板及安装孔
Mounting:固定	Single hole for 1/4" stud 1/4" 单孔固定
Size:尺寸	10.1" (256 mm) W 宽 x 15.0" (381 mm) L 长 x 7" (178 mm) H 高
Weight:重量	10.9 kg (24 lbs) including battery (含电池)
Support Software 支持软件	
Type:类型	QuickTalk and QuickLook for Windows compatible control and retrieval programs. Also operates with DOS communication software 微软的 Window 系统下的 QuickTalk 和 QuickLook 软件包 , 也有 DOS 下的相应软件包
QuickTalk:	Allows easy instrument setup and data retrieval by direct connection or modem at up to 57,600 baud. Also allows rapid viewing of data and generates output to any Windows

	compatible device 直接连接 Modem 可达 56K 波特速率通讯，含在线帮助菜单，可简单安装软件并恢复波形文件。能与任何 Windows 兼容设备连接。
Format converters: 格式转换	Provides option to convert data to SUDS format; (IASPEI software compatible). Consult factory for others. 提供 SUDS/ASCII 转换和存储的程序，(IASPEI 软件可兼容)。如需其它格式的程序，请与公司联系。
Environment 环境	
Operating temp: 运行温度	-20° to 70°C ; Humidity 湿度: 0-100% RH 相对湿度。

Internal EpiSensor Specifications 内置 EpiSensor 的特性

Type 类型	Triaxial force balance accelerometer 三轴力平衡加速度计
Dynamic range 动态范围	145 dB + (EpiSensor noise model available from Kinemetrics)
Bandwidth 带宽	DC to 200 Hz
Calibration coil 标定线圈	Standard 标准
Full-scale range 满刻度范围	User-selectable at $\pm 0.25g$, $\pm 0.5g$, $\pm 1g$, $\pm 2g$ or $\pm 4g$ 用户选择
Full-scale output 满刻度输出 t	User-selectable at: $\pm 2.5V$ single-ended; $\pm 10V$ single-ended; $\pm 5V$, $\pm 20V$ differential 单端、差分，用户可选
Linearity 线性度	$< 1000\mu g / g^2$
Hysteresis 滞后性	$< 0.1\%$ of full scale 满刻度
Cross-axis sensitivity 横轴灵敏度	$< 1\%$ (including misalignment 包括调节不当)
Zero point thermal drift 零点温飘	$< 2\%$ of full-scale 满刻度, -20° to $+70^{\circ} C$
Zero point drift 零点飘移	$< 500\mu g / ^{\circ}C$
Operating temperature 运行温度	-20° to $+70^{\circ} C$ (-40° to $+85^{\circ} C$ with reduced performance 在降低性能时)
Connection 连接	Single military-style metal connector 单个军用型金属连接器

7. Appendix A 附录 A

Formatted K2 Header File 规格化的 K2 头段文件

qlwin.tmp, 02/01/01 13:00:14

To make a permanent copy on hard disk,

use 'FILE: SAVE AS' = eventfile.HDR

QLWIN: F:\ALTUS\AX001.EVT 02/01/2001 12:59

Altus Header, Version. 1.40, S/N 111

K2 Stn: DMP Site:

12 channel unit, 6 channel(s) selected: 1 2 3 4 5 6

Channel(s) triggered: 1

Comment: ABC

UserCodes: 0 0 0 0

Main battery: 13.20V, charging, minimum alarm voltage: 12.0V

24 bit A/D with group delay: 0 msec

Temperature: 27.7 deg.C

Restart Source(s):

None Known.

System Error(s):

None Known.

Altus Time Source: RTC from cold start.

Event Start Time: 2/1/2001 (32) 12:59:05.000

Event Trigger Time: 2/1/2001 (32) 12:59:08.500

Samples per second: 100

Duration: 16.000 seconds, 160 frames

Pre-event: 3 seconds.

Minimum runtime: 0 seconds.

Post event: 10 seconds.

Array Propagation Window: 0 seconds.

Storage: Primary A:, Secondary B:

Digital Field Station OFF.

Program versions: sysBlk 0.00, bootBlk 1.12,
appBlk 2.90, dspBlk 8.89

User input or GPS averaged:

Instrument latitude: 0.000000 Degrees North

Instrument longitude: 0.000000 Degrees East

Instrument elevation: 0 Meters relative sea level.

GPS latitude: 0.00 Degrees North

GPS longitude: 0.00 Degrees East

GPS altitude: 0 Meters relative sea level.

Ch	1	2	3
MaxPeak:	0.0365555V	0.1569498V	0.1905728V
at seconds:	2.590	2.580	4.630
MinPeak:	0.0259382V	-0.1308346V	-0.2011991V
at seconds:	3.930	4.640	3.320
Mean:	0.0301319V	-0.0077528V	-0.0091136V
AcqOffset:	0.0000000V	0.0000000V	0.0000000V

Ch	4	5	6
MaxPeak:	0.0000834V	-0.0000083V	0.0000215V
at seconds:	6.650	15.560	6.070
MinPeak:	0.0000620V	-0.0000274V	0.0000018V
at seconds:	13.620	2.940	11.210
Mean:	0.0000724V	-0.0000188V	0.0000137V
AcqOffset:	0.0000000V	0.0000000V	0.0000000V

Ch	1	2	3
Chan ID:	FIRS,	SECO,	THIR,
Sensors:	EpiSensor(32) s/n 35332	EpiSensor(32) s/n 35333	EpiSensor(32) s/n 35334
MappedChannel:	2	3	1
Inverted:	yes	yes	yes
Displace, N:	0000,	0000,	0000,
Displace, E:	0000,	0000,	0000,
Displace, U:	0000,	0000,	0000,
Alt,Azi(deg):	0, 0	0, 0	0, 0

Ch	4	5	6
Chan ID:	----	----	----
Sensors:	Unknown (0) s/n 0	Unknown (0) s/n 0	Unknown (0) s/n 0
MappedChannel:	4	5	6
Inverted:	no	no	no
Displace, N:	0000,	0000,	0000,
Displace, E:	0000,	0000,	0000,
Displace, U:	0000,	0000,	0000,
Alt,Azi(deg):	0, 0	0, 0	0, 0

Ch	1	2	3
Gain:	1	1	1
Fullscale	2.50V	2.50V	2.50V
Sensitivity:	1.2500V/g	1.2500V/g	1.2500V/g
Damping:	0.6400	0.6700	0.6500
NatFreq:	51.40Hz	53.60Hz	51.20Hz
EpiSensor only:			
CalCoil:	0.0600	0.0600	0.0600
Sensor Gain:	1	1	1
Range:	4g	4g	4g
Sensed Range:	-	-	-
	***	***	***

Ch	4	5	6
----	---	---	---

Gain:	1	1	1
Fullscale	2.50V	2.50V	2.50V
Sensitivity:	1.2500	1.2500	1.2500
Damping:	0.0000	0.0000	0.0000
NatFreq:	0.00Hz	0.00Hz	0.00Hz
EpiSensor only:			
CalCoil:	---	---	---
Sensor Gain:	---	---	---
Range:	---	---	---
Sensed Range:	---	---	---

*** Specified sensor range does not match sensed sensor range.

Ch	1	2	3
Trigger Filter:	Classic SM	Classic SM	Classic SM
Trigger Type:	Threshold	Threshold	Threshold
Threshold:			
Trigger Threshold:	2.000%FS	2.000%FS	2.000%FS
Detrigger Threshold:	2.000%FS	2.000%FS	2.000%FS
STA/LTA:			
STA Length(sec):	----	----	----
LTA Length(sec):	----	----	----
Trigger Ratio:	----	----	----
Detrigger % of Trigger	----	----	----
Alarm Trig Threshold:	2.000%FS	2.000%FS	2.000%FS
Votes:	1	1	1

Ch	4	5	6
Trigger Filter:	Classic SM	Classic SM	Classic SM
Trigger Type:	Threshold	Threshold	Threshold
Threshold:			
Trigger Threshold:	2.000%FS	2.000%FS	2.000%FS
Detrigger Threshold:	2.000%FS	2.000%FS	2.000%FS
STA/LTA:			
STA Length(sec):	----	----	----
LTA Length(sec):	----	----	----
Trigger Ratio:	----	----	----
Detrigger % of Trigger	----	----	----
Alarm Trig Threshold:	2.000%FS	2.000%FS	2.000%FS
Votes:	1	1	1

Anti-alias Filter: Non-causal
 Network Master. Votes: 1
 External Trigger: OFF, Votes: 1
 Keyboard Trigger Votes: 1
 Stream: Votes to trigger: 1, Votes to detrigger: 1

GPS Free Field.
 GPS turn On interval: 30 minutes(s).
 GPS maximum On time: 30 minute(s)
 All times as set manually, or 0 hour(s) from UTC if from GPS
 Clock Source: RTC from cold start.
 GPS Status byte decoded:
 GPS present.
 GPS not locked.
 GPS power is ON.
 GPS state of health byte [same as Acutime SOH byte]:
 Don't have GPS time yet.
 GPS updated the RTC 0 times since last reset.
 Drift at last two RTC updates to UTC: 0 & 0 msec.

Last GPS Update times were:
 1/1/1980 (1) 00:00:00 & 1/1/1980 (1) 00:00:00.
 Last GPS TurnOn times were:
 2/1/2001 (32) 12:56:21 & 2/1/2001 (32) 12:26:21.
 Last GPS Lock times were:
 1/1/1980 (1) 00:00:00 & 1/1/1980 (1) 00:00:00.
 Count of times GPS failed to lock
 within gpsMaxTurnOnTime: 21

Modem strings [NULL TERMINATED] from event header...

Initialization: AT&FE0&C1S0=1&W
 Dialing Prefix: ALTUS
 Dialing Suffix:
 Hangup command: ATH0
 Callout message:
 Callout Acknowledge message:
 Cellular Phone Parameters:
 Power control OFF.
 WarmupTime 0 seconds
 CheckinTime: not active
 Call-In Times: OFF OFF OFF OFF OFF
 Phone Numbers:
 1: EVENT 2:
 Automatic answer/callout OFF.

Wait for connection 45 seconds.
 Pause 10 seconds between calls.
 Extend pause between calls 0 minutes
 Call complete based on MODEM ACK setting (0).
 Max dial attempts: 10.

Serial Data Stream Parameters:
 Mode: One
 Data Format: Compressed
 Disk Buffer Size (16K blocks): 64
 Transmission Sample Rate: OFF
 Samples per Block: 0
 Channel(s) transmitted: 1 2 3

End Altus K2 Header S/N 111, F:\ALTUS\AX001.EVT

QLWIN calculated statistics for all data points in F:\ALTUS\AX001.EVT:

Ch	1	2	3
MaxPeak:	0.0365555V	0.1569498V	0.1905728V
MinPeak:	0.0259382V	-0.1308346V	-0.2011991V
Peak-Peak	0.0106174V	0.2877844V	0.3917719V
Mid-point	0.0312468V	0.0130576V	-0.0053132V
Mean:	0.0301597V	-0.0076415V	-0.0091685V
BaseLine Correction			
Max-Mean:	0.0063958V	0.1645913V	0.1997412V
Min-Mean:	-0.0042215V	-0.1231931V	-0.1920306V

Ch	4	5	6
MaxPeak:	0.0000834V	-0.0000083V	0.0000215V
MinPeak:	0.0000620V	-0.0000274V	0.0000018V
Peak-Peak	0.0000215V	0.0000191V	0.0000197V
Mid-point	0.0000727V	-0.0000179V	0.0000116V
Mean:	0.0000722V	-0.0000175V	0.0000114V

BaseLine Correction

Max-Mean:	0.0000112V	0.0000092V	0.0000100V
Min-Mean:	-0.0000103V	-0.0000099V	-0.0000096V

End QLWIN calculated statistics, F:\ALTUS\AX001.EVT

8. Appendix B 附录 B

ID Bus Address Assignments ID 总线 地址分配

I.D. Group 1 第一 I.D.组

Device	Size	SCL3	SCL2	SCL1	Address	Description
0				X	0	Future Enhancements 将来增强
1	128x8			X	1	109405 Front Panel I/O Board 前面板 I/O 板(may include GPS info 可包含 GPS 信息)
2/3	256x8			X	2/3	109435 K2 Internal FBA Deck 内置 FBA 装置 (2) or 或, 3-Channel 通道 I/O Connector Board 连接板(2-3) or 或, 6-Channel 通道 I/O Connector Board 连接板(2) or 或, 12-Channel 通道 I/O Connector Board 连接板
4	256x8			X	4	K2: 109425 Primary 主 ADC/DSP Board 板 or 或, 109655 FPGA Board 板 (Mt. Whitney ADC Board Expander 扩展板) Makalu: 109590 Primary ADC/DSP board
5				X	5	Preamplifier/Gain Board 前置放大器/增益板
6				X	6	Future Enhancements 将来增强
7	128x8			X	7	109415 PCMCIA Board 板

The I.D. bus output signals — SDA, –WC, SCL1, SCL2, SCL3 — are accessed by writing to port \$E4002 (write-only). The SDA data is read back on bit 4 of port \$E4000. The read and write data are complemented.

I.D. Group 2 第二 I.D.组

Device	Size	SCL3	SCL2	SCL1	Address	Description
8			X		0	Future Enhancements
9	256 x 8		X		1	109420 MCU (Osc Calibration Data, etc.)
10/11	256 x 82	X		2/3		109435 K2 Internal FBA Deck (2) or, 3-Channel I/O Connector Board (2-3) or, 6-Channel I/O Connector Board (2)
12	256 x 8		X		4	K2: 109425 Secondary ADC/DSP Board Makalu: 109590 Secondary ADC/DSP board
13			X		5	Preamplifier/Gain Board (for Secondary ADC Board)
14			X		6	Future Enhancements
15			X		7	Reserved for Secondary PCMCIA Board

I.D. Group 3 第三 I.D.组

Device	Size	SCL3	SCL2	SCL1	Address	Description
16	TBD	X			0	109450 External GPS Interface Board
17		X			1	Other Timing Devices
18		X			2	Future Enhancements
19	128 x 8	X			3	109410 Power Supply Board
20		X			4	Future Enhancements
21		X			5	Future Enhancements
22		X			6	Future Enhancements
23		X			7	109650 Mt. Whitney Mother Board

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